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NATIONAL SCHOOL OF BRIDGES *and* HIGHWAYS PARIS, FRANCE

"L'ECOLE NATIONALE DES PONTS ET CHAUSSÉES"
OF THE
CORPS DES PONTS ET CHAUSSÉES

BY

MAJ. WILLIAM D. CONNOR
CORPS OF ENGINEERS, U. S. ARMY

WASHINGTON
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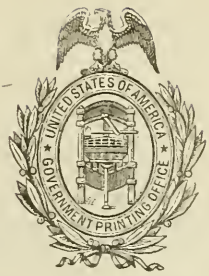

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NATIONAL SCHOOL OF BRIDGES AND HIGHWAYS, PARIS, FRANCE.

"L'Ecole Nationale des Ponts et Chaussées," Corps des Ponts et Chaussées.

The corps of engineers of the French Republic known as the corps des ponts et chaussees, whose duties are similar to the civil duties of the Corps of Engineers, United States Army, is divided into two bodies, engineers and conductors. The engineers, in general terms, are charged with the design and administration of the works assigned to the corps, and the conductors have charge, under the engineers, of the work in the field, the superintendence, inspection, and construction, but are not ordinarily charged with the design or administration of works. The engineers correspond to the officers of the Corps of Engineers of our Army and the conductors to the assistant engineers and junior engineers and inspectors of the Engineer Department at Large. Occasionally conductors of the higher grades are assigned as acting engineers and have the corresponding duties, and a few are from time to time promoted to the actual grade of engineer.

Both bodies are permanent organizations provided by law to carry on the part of the public works of France assigned to the corps des ponts et chaussees, but the recruitment, promotion, and retirement of each are entirely separate, and each goes on, in the two bodies, independently of the other.

CONDUCTORS.

The conductors are divided into five grades, as follows:

Subengineers.
Principal conductors.
Conductors of the first class.
Conductors of the second class.
Conductors of the third class.

They are recruited for the corps entirely by competitive examination, and there is no special school maintained for their education and preparation for the position. In 1908 there were approximately 2,193 conductors and subengineers employed in the corps.

ENGINEERS.

The engineers are divided into seven grades, as follows:

	No. in 1908.
Inspectors general of the first class	29
Inspectors general of the second class	
Chief engineers of the first class	124
Chief engineers of the second class	
Ordinary engineers of the first class	294
Ordinary engineers of the second class	
Ordinary engineers of the third class	

In 1908 there were approximately the number in each grade shown opposite the names of the grades in the above list.

Recruitment.—They are recruited in two ways: First, from the engineer graduates of the National School of Bridges and Highways (Ecole Nationale des Ponts et Chaussées), and, second, by means of promotion, after competitive examinations, from the ranks of the conductors.

All new engineers are first appointed ordinary engineers of the third class. Engineer students of the national school upon satisfactorily completing the course and graduating are at once appointed to that grade. Conductors are thus appointed upon promotion. The requirements for direct promotion are that the conductor shall have served 12 years in that capacity and shall pass a satisfactory examination before the board appointed for that purpose. The examination covers much the same ground as that included in the examinations for passage and graduation from the Ecole des Ponts et Chaussees. This method of entrance to the corps has long been in force, but the difficulties of the examination have operated to keep the number of those who come from the grade of conductor, without graduating from the national school, exceedingly small. The law of 1850 provided that one-sixth of the vacancies in the position of engineer should be filled annually by appointments from the grade of conductor, but that in case there were not a sufficient number of conductors who had passed the examinations the vacancies might be filled from the engineer graduates of the Ecole des Ponts et Chaussees. The difficulties of the entrance examination were such that during the first 19 years that the law was in force no conductor had ever been able to pass them, and the number obtained between 1869 and 1881 was so small that it was decided to allow the conductors to take the course in the school as outside students, and the time while at the school was to count in their 10 years' service then necessary for appointment as engineer in the corps. Between 1869 and 1905 there were 63 conductors who obtained the grade of engineer and 9 of these became chief engineers. Of these 63, 32 were graduates from the national school and 31 came in by competitive examination direct from the conductor class. Such graduation, however, did not authorize the conductors to enter the corps as engineers, but after graduation they still had to pass the examination for entrance provided by the law of 1850. In 1907, however, the conductors were allowed to enter the Ecole des Ponts et Chaussees as engineer students, and at the present time one-fifth of the total number of such students are selected from the subengineers and conductors having at least six years' service and having passed the entrance examinations.

The law of 1907 also provided that all subengineers and conductors who were then actually exercising the functions of engineers should be admitted as engineers of the third class without examination, upon the recommendation of a committee composed of all the inspectors general of the first class of the corps des ponts et chaussees and the directors of the department of public works. The subengineers and conductors were to be admitted from year to year, provided that the number thus admitted in any one year plus the number admitted direct to the corps as a result of a competitive examination should not exceed one-half of the number of engineer

students graduating from the national school in that same year. Subengineers and conductors who were former students of the national school were to be allowed, within 2 years after the passage of this law, to take the entrance examination without having had the 12 years' service. This new law increased the necessary amount of service for entrance to the corps to 12 years instead of 10, of which 6 years must have been active service as a conductor.

The number of positions as engineers open to subengineers or conductors is such that the number of positions of any grade occupied by the nongraduates of the Polytechnic School may be equal to one-third of the total number of such employees covered by the budget of that year.

Examination for grade of conductor.—The competitive examination for entrance to the grade of conductor in the corps des ponts et chaussees consists of two parts—a qualifying examination and an entrance examination. Each applicant for permission to take the examination must be not less than 18 nor more than 30 years of age on January 1 of the year in which the examination is held. Soldiers who have served in the active army may add to this 30 years the number of years that they have served with the colors. Clerks in the corps des ponts et chaussees can add to the 30 years a number of years equal to that of their years of service to the State required to make them eligible for retirement. Candidates for admission must be French born or naturalized.

The qualifying examination is a written examination and covers the following subjects:

Qualifying examination (written).

	Hours allowed.	Weight.	Value.
Orthography and composition	3	7	140
Arithmetic	2	4	80
Algebra	2	2	40
Geometry	2	4	80
Plane trigonometry	2	2	40
Physics and chemistry	3	2	40
Free-hand drawing	2	4	80
Washed drawing	8	6	120
Engineering computations	8	4	80
Surveying	8	5	100
Field work with instruments	(1)	5	100
Total	.....	45	900

[1] As prescribed.

The entrance examination is made up of two parts; the first is written and the second oral.

First entrance examination (written).

	Hours allowed.	Weight.	Value.
Report on some technical matter	4	10	200
Project of some simple work	8	10	200
Working drawing in descriptive geometry (stone cutting or carpentry)	8	10	200
Total	.....	30	600

Second entrance examination (oral).

	Weight.	Value.
Descriptive geometry	3	60
Mechanics and machines	4	80
Hydraulics and strength of materials	4	80
Electricity	5	100
Preparation of a project	5	100
Materials and methods of construction	5	100
Roads and pavements	5	100
Railways and tramways	5	100
Streams, canals, and harbors	5	100
Administrative law and customs of the service	5	100
Total	46	920

The weight assigned to each of these subjects is shown in the tables above. Each subject is marked on a basis of 20. Sixty-six and two-thirds per cent is necessary on the qualifying examination. No one with less than this can take the first entrance examination. No one who does not make at least 66⅔ per cent on the first entrance examination can take the second one, and at least 66⅔ per cent of all the points on the first and second entrance examinations are necessary for entrance to the corps. In arranging the candidates according to rank on their entrance as conductors, a certain weight is given to their length of previous service if any such service exists.

This examination is conducted by a committee of engineers and subengineers or conductors, who prepare and hold the examinations. The papers are marked by separate boards. Even if a candidate passes the examination he can not be appointed a conductor until he is 23 years of age. If younger than this he can be appointed as a clerk and employed in that position until he becomes 23.[1]

EXAMINATION FOR GRADE OF ENGINEER.

The competitive examinations for entrance to the corps des ponts et chaussees, direct from the grade of subengineer or conductor, take place annually. Notification of the date on which they will occur is published at least three months in advance of the examination.

This examination consists of two parts and is held between September 15 and October 15 and between October 15 and December 15. Application for permission to take the examinations must be made by the subengineers or conductors before July 1. The application of each candidate must contain the following information:

1. The year in which he qualified as conductor.
2. Any previous examinations that he may have attempted.
3. A certificate showing his military service.
4. A detailed account of his services since his entrance into the public works, showing the various positions that he has occupied.

This application goes through his chief engineer and the prefect of the department in which he resides. The examination consists of a qualifying examination which is entirely written, and of an entrance examination which is partly written, partly oral, and partly an examination of the record of the candidate.

[1] The conditions for entrance to the corps des ponts et chaussees as a conductor have been merely outlined above. The exact wording of the law, together with a detailed list of the examination subject matter, will be found in the "Annales des Ponts et Chaussees," eighth series, 1907, administrative part, pp. 991–1008, Library of Congress.

Qualifying examination.—The first part of the examination covers the following subjects:

Subject.	Time in hours.	Weight.	Value.
Electricity and its industrial applications	3	1	20
Railroads and tramways	4	1	20
Administrative law	4	2	40
Memoir upon some practical subject connected with the construction and maintenance of ways of communication and maritime ports	5	4	80
Total	16	8	160

The time allowed on each subject and the weight assigned to each are shown in the above list.

Entrance examination.—The second examination consists, first of all, in the preparation of a preliminary project selected by the candidate from one of the following groups of subjects:

Preliminary project for a road, railroad, or tramway.
Preliminary project of a bridge.
Preliminary project of a canal, of the canalization of a river, or of some structure relating to inland navigation.
Preliminary project of a maritime work, of a power house, water-supply plant, or sanitary installation for a city.

The preliminary project is prepared under the inspection of the board during a period of six days. It includes the design, plans, sections, elevations, and profiles, consisting of simple sketches drawn to scale, lettered and figured, and accompanied by an explanatory memoir, memorandum of prices, estimate of cost and specifications for the work. The candidate, moreover, is required to explain verbally the details of his project and to answer questions proposed to him by the board.

Including the project, there is an oral examination upon the following subjects:

Subjects.	Weight.	Value.
Questions regarding construction and maintenance of engineering, structures, ways of communication, and maritime ports: and practical points regarding engineering work	5	100
The customs of the service and accounts	2	40
Administrative law	3	60
Preliminary project:		
Technical part	10	200
Explanatory memoir	2	40
Total	22	440

The weight assigned is shown opposite each subject. The subjects are all marked on a basis of 20.

This examination is taken before an examining board composed of an inspector general of the ponts et chaussees and six engineers below the grade of inspector general, two of whom shall have risen from the grade of conductor or subengineer. No candidate is allowed to take the second examination unless he shall have obtained at least $66\frac{2}{3}$ per cent of the total number of points on the first examination. Passing the first examination qualifies the candidate to present himself for the second at any time within a period of three years, and

during that period he can present himself for the second examination one or more times.

A certain additional mark is given to each candidate, depending upon the work that he has done and the special aptitude that he has shown. These marks are given to the candidates by a committee composed of the vice president of the general council of the ponts et chaussees, all the inspectors general of the first class, and the directors of the department of public works sitting as a board. This committee considers the reports and marks given to the candidate since his entrance into the service, any articles or books that he has published, the marks obtained on the two examinations, and the preliminary project that he submitted. It calls the candidate before it and questions him on the duties and the works with which he has been connected. It also questions the inspector general under whom the candidate has worked and the engineers with whom he may have served. The resulting mark given to each candidate by this committee is multiplied by a coefficient equal to one-half the sum of the coefficients assigned to the matters in both parts of the examination, and the product thus obtained is added to the sum of the points received by the candidate on both of his professional examinations.

The arrangement in order of standing of the successful candidates to be promoted to the grade of engineer is fixed by the committee according to the total number of points received by the candidate in accordance with the above plan. This table is made known to all candidates who were admitted to the second professional examination. Any subengineer or conductor whose name is thus recommended by the committee and who does not obtain his appointment during the following year can have his name carried to the new list for the next year, provided the committee approves.

All examinations are held in Paris, except that qualifying examinations are held in important cities in the various Departments in Algeria, and Tunis to save time and travel. These are held under the surveillance of a chief engineer of the ponts et chaussees and two ordinary engineers.

Any fraud in the examinations eliminates the candidate from the competition and subjects him to disciplinary measures in addition. Candidates undergoing these examinations are considered on duty during the continuance of the same.[1]

L'ECOLE NATIONALE DES PONTS ET CHAUSSEES.

By far the greater number of present members of the corps des ponts et chaussees came from the national school, while under the present law at least two-thirds of future members will come from its graduates. This brings us to the consideration of that school, the great source of recruitment for the corps des ponts et chaussees.

The primary object of this school, conducted under the authority of the minister of public works, is to create a body of engineer students to recruit the engineers of the corps des ponts et chaussees. In addition to this, in so far as they can be accommodated in addition to the

[1] The above merely outlines the regulations and conditions relating to entrance to the corps des ponts et chaussées by direct examination. The exact wording of the law, together with an extremely detailed list of the subject matter of the examinations, will be found on pp. 224–226, first semester, and pp. 226–251, second semester, Annales des Ponts et Chaussées, eighth series, administrative part, 1908, Library of Congress.

engineer students, the school is intended to give instruction to such outside students as may desire to obtain the higher engineering diploma conferred by the school.

The school also receives foreigners as "outside students," and gives instruction to other Frenchmen and foreigners, not candidates for diplomas, under the title of "free listeners."

The object of the instruction in the school is, in general, to provide knowledge of the construction and maintenance of highways, railroads, canals, maritime ports, and such works as may be intended to insure navigation and maintain the regimen of the rivers and streams, and, in general, everything which pertains to ways of communication by land or water. It also includes the subjects of irrigation, drainage, control of streams, power houses, and the distribution of water. As necessary to provide such knowledge the course includes the following subjects: Mechanics, civil architecture, fortifications, mineralogy, geology, applied chemistry, agricultural and urban hydraulics, applied electricity, administrative law, the living languages, and political and social economy. Wireless telegraphy and the other applications of electricity, aeronautics, photography, and fish culture are also covered in special lectures. The school is practically a school of application in which selected graduates of the Polytechnic School and selected subengineers and conductors are specially trained for the design and administration of that part of the public works assigned to the corps des ponts et chaussees and in which others, as outside students, are similarly prepared for the engineering work of civil life. This is known as the special or regular course. In addition to the regular course there is a preparatory course for students who are not graduates of the Polytechnic School, intended to cover the scientific subjects that are necessary to fit them for the higher technical instruction as outside students of the special course.

HISTORY.

The creation of the National School of Bridges and Highways (l'Ecole Nationale des Ponts et Chaussees) dates back more than 150 years.

About 1744, on the recommendation of Trudaine, intendant of finance, it was decided to create a bureau of designers and draftsmen and a depot of plans which should be devoted to the preparation of plans and maps of the great highways and other routes of communication of France. M. Perronet, then engineer of the district of Alencon, was placed in charge of the bureau and depot.

The new institution, in addition to the services mentioned, was intended to instruct the above-mentioned designers and draftsmen in the theory and practical knowledge necessary to fulfill satisfactorily the different positions in the corps des ponts et chaussees.

Such is the origin of the Ecole Nationale des Ponts et Chaussees.

The corps des ponts et chaussees dates back to still an earlier period, having been instituted by decree of the royal council February 16, 1716. Up to 1744 the recruitment of the corps des ponts et chaussees was carried on without any fixed rule from among the various employees who had shown talent in the practical work of construction.

After 1760 the bureau of designers appears under its old name, and also under the new name of the Ecole des Ponts et Chaussées. The present name first appears as the official title in the instructions issued by Turgot, February 19, 1775.

Its personnel was made up of 70 employees, who were divided into three classes—the subengineers or inspectors, the student employees, and certain other young men under instruction called assistants.

The weak part of the institution was the instruction. The brighter students of each class were forced to make an outside study in the subjects of architecture, physics, and mineralogy, and afterwards to teach them to their comrades in the class, together with pure mathematics, mechanics, stereotomy, and drafting. Such was the state of the school at the outbreak of the Revolution.

On the 19th of January, 1791, the National Assembly passed a law containing the following provisions:

1. There shall be a free school of the ponts et chaussées.
2. This school shall be directed by a chief engineer and by an inspector under his orders.
3. There shall be a fixed course of instruction, and the positions of professors shall continue to be filled by such students as, after competitive examinations, shall be judged most worthy of these positions.
4. Sixty students shall be admitted to the school, and they shall be divided into 3 classes of 20 each.
5. The students shall be chosen from all the departments of France as a result of public competitive examinations passed before a special examining board.
6. The students shall be appointed.

In 1794 the foundation, under the War Department, of the school for the public works, now called the Polytechnic School, gave rise to a critical situation in the fortunes of the Ecole des Ponts et Chaussées. The plan was discussed of substituting the Polytechnic School for all the other special schools of the State, but fortunately this plan was abandoned and the law of October 22, 1795, definitely settled the relations between these different schools. This law, in addition to other important dispositions, provided as follows:

First. The Ecole des Ponts et Chaussées, created in 1747 and again continued in accordance with the law of January 17, 1791, is to be continued as a school of application. * * *

Fourth. The students shall be drawn from the Polytechnic School. * * *

Fifth. The instruction given in the Ecole des Ponts et Chaussées shall be intended principally for the application of the physical and mathematical principles to the art of designing and constructing buildings and works connected with highways, canals, maritime ports and the structures which pertain thereto.

This new method of recruiting the corps from amongst students previously prepared in the Polytechnic School necessarily introduced certain fundamental modifications in the system of instruction in the national school, henceforth to be a school of application.

In 1798 the new course of instruction was approved. It provided that the instruction in the school should thereafter be intrusted to three professors charged with teaching the following courses:

First. Applied mechanics.
Second. Stereotomy applied to arts of design, stonecutting, and carpentry.
Third. Construction work and the arts and trades connected therewith.

When the imperial decree of August 25, 1804, again established the organization of the school, no notable change was wrought in the

interior régime, the methods of interior work, nor the discipline of the school.

The reorganization therein provided for has continued in force nearly up to the present time and its main provisions concerning the organization of the school were continued in the decree of July 18, 1890.

Certain modifications have been wrought in this fundamental decree by the later decrees of July 20, 1893, December 19, 1899, October 30, 1900, February 2, 1906, April 3, 1909, and finally by the law of December 24, 1907, concerning the recruitment for the engineers of the ponts et chaussees, but its main controlling conditions still exist.

FINANCES.

The school is supported entirely by the Federal Government of France, and as the instruction is entirely free there is no income from the tuition of the students.

The following is a copy of the budget of the school for the year 1912:

Personnel:		
Direction and inspection of the special course	$12,550	
Direction and inspection of the preparatory course	2,280	
The library and secretary's office	9,285	
Employees of the school	3,400	
		$27,515
Allotments and various expenses:		
Field work, surveys, etc	50	
Entrance examinations	100	
Laboratory work	100	
Laboratory assistant	100	
Commutation of quarters	1,632	
Prizes for good services	500	
Overtime for employees	147	
Allowances for employees	180	
Alms	60	
		2,869
Materials and various expenses:		
Practical work in construction	1,900	
Field work in surveys	240	
Laboratory	1,000	
Gallery of models	400	
Repairs to buildings	850	
Repairs to furniture and apparatus	700	
Cleaning	240	
Furniture	240	
Uniforms for servants	252	
Laundry work	120	
Heating and lighting	2,874	
Transportation of books, instruments, etc	30	
Stationery and supplies	184	
Postage	20	
New Year's presents to servants	16	
		9,066
Laboratories:		
Operating expenses of various laboratories	2,610	
Uniforms, working clothes, etc	54	
		2,664
Total for the school proper		42,114

In addition to the above expenses, which are purely for the school, there are the following from the same budget that pertain to the depot

of instruments and bureau of plans and maps which are used in many ways in connection with the schools:

Uniforms	$60	
Stationery and supplies	86	
Bureau of draftsmen	3,740	
Photographic laboratory	3,488	
Subordinate employees	660	
Publication of the Annales des Ponts et Chaussees	1,000	
Salaries	8,440	
Subordinate employees	800	
		$18,226

In addition to the above, there are attached to the school:

1 inspector general of the first class, at $3,500	$3,500	
3 inspectors general, at $3,200	9,600	
13 chief engineers, at $2,200	28,600	
1 engineer, ordinary, at $1,400	1,400	
6 professors, at about $1,000	6,000	
Total		49,100
Grand total		109,440

ORGANIZATION AND ADMINISTRATION OF THE SCHOOL.

The school is directly under the control of the minister of public works, to whom matters concerning the school go immediately from the director of the school unless the previous action of the school board or council is necessary.

Director.—The school is administered by an inspector general of the first class of the corps des ponts et chaussees, who bears the title of director of the school. He is charged with seeing that the regulations are carried into effect and obeyed. He reports to the minister everything with regard to the instruction, policing, and administration of the school, and he has charge of the depots which are attached thereto.

Inspector.—A chief engineer or an inspector general of the second class assists the director and is in charge of the studies. He is called the inspector of the school. He is particularly charged with all the details of instruction. He exercises a daily supervision over all parts of the instruction and reports to the director and, when necessary, to the school board, such facts as have a bearing upon the instruction, order, and discipline. He has charge of the accounts and returns of the school and is in charge of the library and museums. Both the director and inspector are appointed by the President of the Republic.

Professors, repetiteurs, and masters.—The subjects forming special departments or courses in the school will be given later in detail. Ordinarily each course is in charge of a separate professor. Occasionally one professor will be able to handle two courses, but this is the exception and not the rule. The instruction in military science is given by an engineer officer of the army nominated by the minister of public works and detailed for that purpose by the war department. In addition to the professors the personnel charged with the instruction includes one chief of graphical works, one head master of drawing, and a master of German and one of English. Such new chairs as may be desirable from time to time can be created by decree upon the recommendation of the minister of public works upon the advice

of the school board and the council of improvement. In case of necessity and upon the recommendation of the school board one or more assistant professors or repetiteurs may be attached to the department of any particular course either in the special or in the preparatory school. Professors, assistant professors, and repetiteurs, either in the special school or the preparatory school, the chief of graphical works, and the masters are appointed by the minister upon recommendation presented for each vacancy by the school board. Practically all the professors of the school are drawn from the corps des ponts et chaussees or the corps des mines or des telegraphes. The exceptions are the professors of law and languages and military instruction. They come from the state department, civil life, and the war department, respectively.

A few of the professors are detailed exclusively on this duty; the others are all actively engaged in the work of their corps, and all are men selected for their peculiar fitness or ability in that particular line. All the positions are held for several years consecutively during satisfactory service and a few are permanent positions.

These details as professors are exceedingly desirable, as the position is looked upon as a stepping stone to a higher appointment and the selection for the place is and has always been a very high compliment.

The courses are so arranged that the professor is not kept away from his work for more than one or two days a week and usually for only about 30 or 40 days during the year plus the time for examinations and board meetings. These few days at a time do not interfere materially with his other duties.

The chief engineer of the lighthouse service and the chief engineer of one of the large canals now under construction occupy positions as professors at the present time—1912.

Persons who, through their connection with special works, have acquired exceptional knowledge upon certain branches of the engineering science can be called by the minister, either directly or upon the recommendation of the school board, to come temporarily and give lectures to the students on the subjects covered by their special knowledge.

Functionaries and agents.—Attached to the school administration there are certain functionaries and agents. These consist of an administrative secretary, a librarian, two inspectors, and a doctor, and such number of draftsmen, clerks, and servants as may be judged necessary for the instruction and for the depots attached to the school. The permanent functionaries and agents are appointed by the minister upon the recommendation of the director of the school. The auxiliary agents or those whom it may be necessary to employ temporarily are chosen by the director of the school upon the recommendation of the inspector.

SCHOOL BOARDS OR COUNCILS.

School board.—All important propositions bearing upon the instruction, the interior working, or the discipline of the school before being submitted for approval to the minister are submitted to the action of a council called the school board, whose duties and functions are largely those of the academic boards or school boards of corresponding schools in America.

This council of instruction, or school board, is made up of the director, the inspector, two inspectors general of the first class of the corps des ponts et chaussees, all the professors of the school, and the president of the society of engineers, formerly outside students.

This board meets upon call of the minister of public works, or the director of the school, as often as may be necessary and at least once every two months during the school year. A majority of the members of the board is necessary to constitute a quorum. In case of a division, the vote of the president is preponderating. The board is necessarily called to deliberate upon questions concerning the course of instruction and the student body and especially upon questions of the retardation or the advancement of students from one class to another, of dropping them for deficiency in studies, or of expelling them from the school.

It fixes the lists showing the class standing from year to year and upon graduation. Its decisions on these matters can only be changed to correct mistakes in the application of the school regulations. It discusses and submits for the approval of the minister the conditions for admission as well as those for the courses, and the rules to be applied in marking the work of the students. It gives its advice upon any other questions that may arise in connection with the school, which may be referred to it either by the director of the school or by the minister, or which may be presented by a member of the school board after previous consultation with the school authorities. The minutes of the board are submitted for the approval of the minister.

Council of improvement.—There is a higher board called the council of improvement, which meets at the end of every academic year in order to fix the list of prizes to be awarded to students and to discuss any measures which may be suggested with the object of improving the course of instruction.

This council of improvement comprises certain ex officio members and certain other members appointed by decree upon the recommendation of the minister of public works.

The ex officio members are:

1. The director of the school, president.
2. The inspector of the school, secretary.
3. Four professors of the school designated annually by the school board.
4. The directors of the central administration of the department of public works.
5. The director of the state railways.
6. The vice president of the general council of the ponts et chaussees.
7. Three members of the general council of the ponts et chaussees designated by that council.
8. The inspector general of hydraulic works in the department of the marine.
9. The inspector general of the colonial public works in the department of the colonies.
10. The director of hydraulics and of agricultural improvements in the department of agriculture.
11. The director of the school of mines.
12. The director of studies of the polytechnic school.
13. The president of the friendly association of engineers, formerly outside students in the school.

The following are appointed by decree to serve for two years:

1. Six representatives of the railway interests or other industries connected with transportation and electricity.
2. Three contractors on the public works.

Of these last nine, at least four must be chosen from old graduates of the school.

The director presides at meetings of this council and the inspector fills the position of secretary.

This council meets at the end of the school year in order to judge of the merits of the combined work produced by the students and to propose such measures as it may think useful or necessary for improving the course of instruction.

The annual session of this council is divided into two distinct parts. In the first part it sits as a jury or examining board and after an inspection of the provisional classification of the students prepared by the professors it fixes the list of prizes and honorable mentions to be given to the students. Its decisions in these matters are final. In the second part of the session the council discusses any measures which may be suggested to it for the purpose of improving the course of instruction, and recommends to the approval of the minister such of these measures as it deems worthy of trial. In the first part of the session the professors who are not members of the council are present at its meetings and have a consulting voice. Each of them has a deliberative voice in connection with questions which concern the course of instruction confided to his charge. Separate minutes are prepared for the proceedings of the council at both of these sessions. The minutes are sent to the minister, who acts upon the proposals made by the council of improvement, the school board having been consulted. The session of the council must be completed within 15 days after the date of its first meeting, but in case of necessity the council can be ordered to meet in extra session by the minister.

COURSES OF INSTRUCTION.

The course of instruction is divided into two parts, the preparatory course and the special course.

Preparatory course.—In order to give to such young men as may wish to be admitted to the school as outside students a satisfactory means of preparing themselves for the higher technical instruction in the special school, a preparatory course has been organized. The subjects taught in this course are such as are usually taught during the first year in a good engineering college in this country. It covers the mathematical and scientific matter necessary for a good foundation to the later technical instruction.

The duration of this preparatory course is one year, and it is intended to give its students a condensed course of instruction corresponding to that received by the engineer students during their two years in the Polytechnic School. This instruction is altogether free. Admission to the preparatory course is by means of a competitive examination, which is given before an examining board appointed by the minister of public works upon the recommendation of the director of the school.

Matters taught in the preparatory courses are regulated by ministerial decree on the recommendation of the school board and the advice of the council of improvement.

Special course.—The special course includes the subjects usually taught in the last three years of a good engineering school in this country. It includes a three years' course of instruction in the school

proper, and a certain amount of practical instruction while on special missions during the summer vacations to the different classes of engineering work under engineers having charge of important works in the course of construction.

The work of the school proper takes place during the months from November to May, inclusive. The missions embrace the period from June 1 to October 15.

The course supplements the subject matter taught in the Polytechnic School and the preparatory course. Admission to the special course is by graduation from the preparatory course or from the polytechnic school, by a competitive examination, or by appointment with permission to enter without examination. The instruction is entirely free.

STUDENTS.

Classification.—The student body of the national school is made up as follows:

1. Engineer students.
2. Outside students.
3. Foreign students.
4. Free listeners.

Engineer students.—This class makes up the body of students for whose education the school especially exists. They are the selected graduates of the Polytechnic School or men of the conductor class from the corps des ponts et chaussees who are being specially prepared for appointment to that corps, as engineers, upon graduation.

Four-fifths of these engineer students are recruited from the selected graduates of the Polytechnic School recommended upon their graduation for the service of the ponts et chaussees and one-fifth from among subengineers and conductors of the ponts et chaussees, who have passed a competitive examination for admission to the school to which entrance examination they have been authorized to present themselves by passing a qualifying examination.

By the law of December 24, 1907, all engineer students are on the same footing as regards pay, allowances, standing, and appointment to the corps des ponts et chaussees after graduation. The number admitted annually is determined by the probable number of vacancies in the corps des ponts et chaussees and is usually less than 20.

Outside students.—The outside students are made up of Frenchmen and foreigners who desire to avail themselves of the splendid course of engineering instruction given in the national school, but who are not candidates for admission to the corps des ponts et chaussees. There are usually 20 to 25 such students, of whom 4 or 5 are foreigners, admitted annually.

The graduates of the preparatory school form a preferred list of outside students. From an examination of the minutes showing the results of the various examinations undergone by the candidates and upon the advice of the school board, the minister annually fixes the list of the remaining outside students to be admitted to the course and to participate in the interior work of the school. All outside students compete among themselves as to their arrangement in order of merit. Aside from that, they follow exactly the same course as the engineer students as regards the instruction, examinations, and other

exercises of the school. Their instruction covers a period of three years and is entirely free. Upon application, these outside students during the vacations may receive authority to visit public works in course of construction, and in 1911 the council of improvement recommended that they be compelled to utilize their vacations in some such manner. Such of these as at the end of the course of study have satisfied all the conditions required in the school receive from the minister of public works the diploma of engineer of civil constructions, conforming to the instruction that they have received.

Foreign students.—This class of students is made up of two parts; first, those who desire to take the course for the same reason as the outside students above mentioned and who are on practically the same footing as French outside students; and second, those who are representatives or officials of foreign Governments who are given special privileges in the way of freedom from entrance examinations.

Each foreign student must present his application for admission to the minister of public works through the minister of foreign affairs. His application must be previously submitted for the approval of the representative of his own Government at Paris, by whom the application must be favorably indorsed.

Before their admission to school foreign students must undergo an examination intended to show their knowledge and demonstrate their fitness to follow the course.

They are ordered to be admitted by the department upon the advice of the examining board and the recommendation of the school board.

They can only obtain such places in the study rooms as shall remain available after French students have been provided for. The director of the school may authorize foreign students to follow the lessons of certain nonpublic courses.

Free listeners.—This last class of students consists of Frenchmen and foreigners who, for any reason, are not candidates either for governmental positions or for diplomas. They are permitted to attend all or part of the lectures by written permission of the director of the school. The number of this class of students is approximately from 50 to 60, of whom about one-third are usually foreigners. This class of student is not required to take the examinations, the projects or practical work, nor to go on missions, but on the other hand he receives no diploma for his work at the school. The advantage that he obtains consists entirely in the amplification of his knowledge on engineering subjects.

Occasionally Frenchmen from other public departments are sent to take the course as "free listeners." They are considered as students and can take the examinations and be admitted to the library of the school.

The list of students to be admitted to the school each year is made up as follows:

First come the students of the preparatory school, who in consequence of their examination standing at the end of the year have obtained such marks as satisfy the school board.

Then are listed, in the order of their rank of graduation from the Polytechnic School, those students who have just graduated from that

institution, but only such number as to fill the number of places fixed for that year by the school board.

Then come the candidates from the conductor class of the ponts et chaussees, who are admitted to a number equal to one-fourth the number admitted from the Polytechnic School.

Vacancies remaining after the above lists have been made out are then open to the competitive examination for candidates as outside students.

The number of vacancies and the order of standing in the entrance examinations for both the special and preparatory courses are immediately sent to the minister with the marks of the students and the recommendations of the examining board and the proposals of the school board.

The minister definitely fixes the lists of admission and transmits them immediately to the director of the school in order that he may promptly prepare the certificates to be submitted to the military authorities by the new students.

Number.—The number of engineer students admitted to the national school varies from 15 to 20 yearly. The number admitted under the other classes of students depends upon the number successfully passing the entrance examinations and the capacity of the school.

The students are divided into three classes, corresponding to the annual graduating classes from the Polytechnic School.

In the year 1910–11 there were 135 students in the school, arranged as follows:

PREPARATORY SCHOOL.

Number in the preparatory school, 22.

In addition there were 18 who were then in the military service.

SPECIAL SCHOOL.

Engineer students.

Class.	From the polytechnic school.	Conductors and sub-engineers.
First	12	3
Second	3	
Third	17	3
Total	38	

There were 20 engineer students of the third class undergoing their military service in regiments, of whom 18 were to enter the school in November, 1911, and 2 in November, 1912.

Outside students (French and foreign).

First class	26
Second class	27
Third class	22

One outside student of the third class was performing his military service and was to enter the school, beginning November 3, 1912.

Nationality.—The above-mentioned outside students were divided as follows, according to nationality:

	Special school.	Preparatory school.
French	63	17
Russian	5	1
Turkish	3	2
Egyptian	1	.....
Greek	2	.....
Chinese	1	1
Cochin Chinese	.....	1
Total	75	22

All engineer students are Frenchmen.

Free listeners.—During this year there were 55 free listeners, of whom 28 were foreigners, divided amongst the various nationalities as follows:

Nationality.	Number.	Nationality.	Number.
Russian	6	Greek	1
Polish	3	American	2
Syrian	1	Peruvian	3
Armenian	2	Argentinian	2
Turkish	6		
Spanish	1	Total	28
Portuguese	1		

Age.—Every candidate for appointment as outside student in the preparatory course or special course must be a Frenchman, born or naturalized. He must be between 17 and 21 years of age on the 1st of January of the year in which he enters the preparatory school and between 18 and 25 on the 1st of January of the year in which he enters the special school. This age limit is increased to 27 years in the special school for such candidates as have served their two years in the army.

Salary.—The engineer students in all the classes receive a yearly salary of $480 with an additional yearly allowance of $120 as a sort of commutation of quarters during their stay in Paris. To this is added an additional allowance of $100 a year and traveling expenses to cover their expenses while on missions to the public works during the summer months.

The other students, of course, receive no pay or compensation.

ENTRANCE EXAMINATIONS.

Preparatory school.—Admission to the preparatory school can only be obtained by passing an examination which is held in Paris at a time determined by the minister of public works. These examinations are held before an examining board appointed by the minister upon the recommendation of the director of the school. They follow a program fixed by ministerial decree. The minister determines annually and publishes in the official journal both the announcement of the date of the examination and the maximum number of admis-

sions that will be allowed in the preparatory course. The application for admission to the examination must be addressed to the minister of public works. It must be made before May 15 and be accompanied by the following papers:

1. A birth certificate showing French birth or the necessary papers to show French naturalization.
2. A duly attested certificate of good morals from the mayor of the place of residence of the candidate.
3. An attested certificate of a physician showing vaccination or that the candidate has had smallpox.
4. A medical certificate of physical fitness certified to by the mayor of the candidate's place of residence.
5. The approval of parents or guardians in case the candidate is a minor.

The competitive examination for admission to the school takes place annually at the Ecole des Ponts et Chaussees some time during June or July.

The entrance examination to the preparatory school is divided into two parts. The first part is written and the second part is oral, and only those who pass the written examination satisfactorily (drafting not included) are admitted to the oral examination.

The written examination covers the following subjects:

1. Algebra.
2. Analytical geometry.
3. Mechanics.
4. Descriptive geometry.
5. Arithmetic, with or without the use of logarithms.
6. A geometrical drawing, drawn from a relief model.

The geometrical drawing is only given to those students who have passed successfully the examination subjects 1 to 5, inclusive.

The oral examination.—The oral examination covers the preceding subjects and in addition trigonometry, physics, and chemistry.

In both the written and the oral examination all the subjects are marked on the scale of 20 and all subjects are given the same weight, except that in the oral examination trigonometry and analytical geometry are counted as one subject.

No student who, through failure in studies or by disciplinary measures, has been separated from the school can present himself again for a competitive examination to the preparatory course.

Special school.—Applications for admission to the examination for the special school as an outside student are submitted at the same time and accompanied by the same papers and information as provided for the preparatory school. No examinations, applications, nor papers are required from graduates from the preparatory school.

Applications for admission to the examinations for engineer students must be made by the subengineers or conductors before July 1. The application must contain the following information and must be submitted through his chief engineer and the prefect of the department in which he resides:

1. The year in which he qualified as conductor.
2. The foreign language upon which he desires to be examined.
3. Any previous examinations that he may have attempted.
4. A certificate showing his military service.
5. Detailed account of his service since entrance into the public works, with the various positions that he has occupied.

The examinations for entrance to the special school consist in written compositions, in the execution of certain designs, and in oral

examinations. They take place annually in the months of June or July for outside students and of September or October for engineer students. The examining board for the outside students is composed as follows: One inspector general of the corps des ponts et chaussees, president; and six examiners chosen from among the chief engineers or ordinary engineers of the corps des ponts et chaussees, the professors of the National School of the Corps des Ponts et Chaussees or of the National Higher School of Mines. For the examinations for the conductors the board is similar, but two of its members must be selected from among the engineers taken from the ranks of the subengineers and conductors. The members of the board are appointed each year by a decree of the minister of public works. The program and conditions for these competitive examinations are fixed by the decree of April 17, 1908, for the recruitment of engineer students from subengineers and conductors of the ponts et chaussees and are the same for entrance as outside students.

This examination is made up of two parts: (1) A qualifying examination and (2) an entrance examination. The first is entirely written, the second entirely oral.

The qualifying examination covers the following subjects:

Subject.	Time in hours.	Weight.	Value.
Algebra and analytics	4	3	60
Geometry and mechanics	4	3	60
Descriptive geometry	3	2	40
Total			160

The entrance examination covers the following subjects:

Subject.	Weight.	Value.
Algebra and analytics	2	40
Geometry	2	40
Mechanics	2	40
Physics and chemistry	2	40
English or German (optional)	½	10
Total		170

The mark obtained on languages does not count in deciding whether the candidate has passed or not. It is only added to his mark when determining his order of standing among the other successful candidates.

This examination is entirely oral. Each subject is marked on a basis of 20, and the sum of the marks multiplied by their weights gives the resulting mark for the examination. No candidate is allowed to attempt this examination more than three times. No one is allowed to take the oral examination who has not received at least 60 per cent of the maximum number of points obtainable on the written examination; and no one is allowed to enter the school who has not received at least 66⅔ per cent of the maximum number obtainable on the two examinations together.

A program for the entrance examinations to both the preparatory and special schools as either an engineer or outside student is fixed by ministerial decree and enumerates with great detail the subject matter of the examinations that these candidates must pass. This program is too extensive to include even a summary of it in this report. It is on file in the library, United States Engineer School No. 620.7 F815, E, 1.

Foreign outside students undergo an examination covering the same subject matter as French students. Under exceptional circumstances and upon the recommendation of the school board foreign students may be excused from all or part of the examinations. This freedom from examination is only accorded to public officials recommended as such by their governments, and the administration can always require them to undergo an examination before admission if it so desires.

Program of the course.—In order to establish the best practicable system in each course of instruction and to avoid the possibility of any duplication of instruction in the courses given by different professors, each course is always clearly defined as to the framework of the matter taught therein. The progress of science and the necessary increase of lessons in consequence thereof have compelled a recent complete revision of these programs of instruction. They are carefully prepared by the school board and are approved by ministerial decree.

This program is published under the department of public works and shows in the minutest detail the subject matter included in each course in the school and the order in which it is taught. It forms an excellent framework for the professors in laying out their work and for the students in following the same, and practically consists of the subheads that would appear in a table of contents if all the lectures were published in book form. This program is entirely too long for publication in this report and is not capable of summarization beyond its present form. A copy of the present program is on file in the library of the United States Engineer School: "Programmes de L'Enseignement Interieur de L'Ecole Nationale des Ponts et Chaussees," No. 620.7 F815, E, 1.

ABSTRACT OF THE COURSES.

Preparatory school.—The following is an abstract of the one year's course in the preparatory school:

Course.	Number of lectures.	Professor.	Rank of professor. (1)
Analytics and mechanics	20 20	Maillet	2
Applied geometry	31	d'Ocagne	2
Architecture	30	Pillet	10
Physics	40	Mesnager	2
Chemistry	30	Etienne	.....
Quizzes in analytics	15	(2)	.....
Quizzes in mechanics	17	(2)	.....
German	20	Mathis	7
English	20	Garnier	7
Military instruction	39	Chambeau	8–7

[1] See footnotes to table on page 23. [2] Not yet assigned.

Special course.—The following is an abstract of the courses in the special school covering the three years' course:

The first year or third class includes nine courses; the second year or second class includes seven courses, and the third year or first class includes five courses. In addition to these, in each class there are 20 lessons in English and 20 in German, and 19 in military instruction. The following is the list of the courses:

Name of course.	Number of lessons.	Name and rank of professors.
First year, third class:		
Applied mechanics (strength of materials)	36	Resal, 1.
Materials of construction	24	Mesnager, 2.
Methods of construction	30	Felix Launay, 2.
Highways and tramways	26	Heude, 1.
Topography and measurement of earthworks	10	d'Ocagne, 2.
Applied electricity	32	Guillebot de Nerville, 3.
	9	Picou, 4.
Mineralogy and geology	30	De Launay, 5.
Architecture	17	Bonnet, 2.
Social economy	20	Gide, 6.
German	20	Mathis, 7
English	20	Garnier, 7.
Military instruction	20	Chambeau, 7, 8.
Total	294	
Second year, second class:		
Applied mechanics (hydraulics)	20	Rabut, 2.
Metal bridges	16	Resal, 1.
Masonry bridges	22	Sejourne, 2.
Inland navigation	35	Dusuzeau, 2.
Maritime works	35	De Joly, 2.
Railroads	33	Fouan, 2.
Administrative law (first part)	20	Chareyre, 9.
German	20	Mathis, 7.
English	20	Garnier, 7.
Military instruction	19	Chambeau, 7, 8.
Total	240	
Third year, first class:		
Reenforced concrete and experimental mechanics of solids	20	Rabut, 2.
Steam engines and other thermal motors	34	Walckenaer, 5.
Agricultural and urban hydraulics	32	Bechmann, 2.
Political economy and finances	36	Colson, 1.
Administrative law (second part)	39	Romieu, 8.
German	20	Mathis, 7.
English	20	Garnier, 7.
Military instruction	19	Chambeau, 7, 8.
Total	219	

1. Inspector general, ponts et chausses.
2. Chief engineer, ponts et chausses.
3. Chief engineer of telegraphs.
4. Engineer of arts and manufactures.
5. Chief engineer of mines.
6. Professor in Law School of Paris.
7. Not on school board. Master of languages.
8. Captain of engineers, French army.
9. Counsellor of state.
10. Professor of architecture.

SCHOOL YEAR AND DAILY SCHOOL HOURS.

The school year begins annually during the first half of November and lasts until May 31. During the entire academic year students must be present in the school daily, Sundays and holidays excepted, from 8 a. m. to 11.30 a. m., and from 1 p. m. to 5 p. m. In case of sickness or other serious interruption necessitating a forced suspension of work, the minister may, upon recommendation of the school board, authorize a student to take the year's work over a second time.

The school building is open from 8 a. m. to 7 p. m. except on Sundays and holidays, when it is open from 10 a. m. until 5 p. m.

HOUSING AND FEEDING OF STUDENTS.

The students room and eat wherever they desire outside of the school, there being no dormitories or messes attached thereto. They are required to be present at all lectures given in the school and all exercises, tests, laboratory sessions, and tours of inspection, and are supposed to work in the study rooms or library during the rest of the school hours.

METHODS OF INSTRUCTION.

The instruction in the school consists of the following:

1. Oral lectures given by the professors, of whom there are 21.
2. Studies of graphical works and the preparation of memoirs and projects.
3. Chemical, physical, and electrical laboratory work and work in the laboratory for testing materials.
4. Field exercises with surveying instruments.
5. Visits to engineering works under construction, workshops, power houses, industrial establishments, port works, quarries, etc.
6. Missions on engineering works during the summer vacations.

The course in administrative law is optional for foreign students only.

The course of fortifications is obligatory for French students and can not be taken by foreign students without special authority from the minister.

The system of instruction for students in the special school is divided into two parts: First, the system of instruction in the school proper from November to June 1, and, second, the system of instruction in the practical work obtained on their missions on the public works or elsewhere from June to November.

The entire time of the student is thus utilized, and although the missions take up practically the entire summer they form such a change of work and surroundings that all the advantages of a vacation accrue together with those of actual experience with working conditions and methods.

Outside students follow the same course in all respects as engineer students.

The department of public works, upon recommendation of the school board, fixes the subdivision of matter to be taught in each of the three years, the number of lessons, the days and hours corresponding thereto.

The period of instruction is immediately followed by that of examination at the end of the year. These examinations are given and marked by the professor in charge of the course, and any other members of the school board who desire can be present. They usually last from about March 20 to May 31 in the special school and from May 15 to June 15 in the preparatory school.

All the foregoing rules in regard to the students are applied subject to changes due to the tours of military duty that may be required of the individuals.

Lecture course.—The backbone of the course is the series of lectures given on each subject, and given as they are by men who are actively

engaged in work on the subjects covered by their lecture courses, and who are selected men in their various lines, this method involves the maximum amount of practical instruction that can be given in a theoretical course.

The various courses run concurrently, one or two lectures being given on each subject every week. The lectures last from an hour to an hour and a half, and at the end the students are allowed to ask questions to clear up any points which they have missed. The students take notes and keep them in permanent notebooks.

The lectures are well illustrated by models, large scale drawings, and by sketches made on the blackboard by the professor.

To the normal course of the school there are added a certain number of lectures which include applied electricity, petrography, and paleontology, and cover recent developments in certain scientific subjects, such as wireless telegraphy, aviation, etc.

In most of the courses the students have a summary of the lectures in lithograph sheets, and these taken with their notes give them a complete outline of all the most important points covered by the lecture.

A complete set of these lithographed courses was obtained and is on file in the library of the engineer school. A list of them is given later in this report.

Projects.—Next in importance to the lecture course comes the projects required from time to time during the course. They consist in the design of certain works already covered by the lectures together with plans and estimates for the work. They come as near practical work as is possible under school conditions when actual responsibility for success or failure can not be included. These must be turned in at a specified time and a certain amount is deducted from the mark for each day's delay thereafter. These projects are required in both the preparatory and special schools, increasing in importance and in practical application as the student's knowledge increases.

During the year the students in the preparatory school have to submit many small studies or projects on three different subjects. In the special school the students of the first year must furnish between November 3 and April 1 three projects consisting of six studies; those of the second class and of the first class five projects each. These projects are equivalent to a formal monthly examination and require about one-half of the time assigned for the school work.

The following projects are required from the various classes during the different years:

PREPARATORY SCHOOL.

1. Architecture (25 drawings, 3 projects).
2. Applied geometry (11 problems).
3. Mechanics (1 project).

SPECIAL SCHOOL.

First year or third class.

1. Architecture (consisting of three parts).
2. Mechanics (consisting of two parts).
3. Roads (consisting of one part).

Second year or second class.

1. Architecture (consisting of one part).
2. Mechanics (consisting of two projects).
3. Large masonry bridge (consisting of one part).
4. Inland navigation (consisting of one part).
5. Applied electricity (consisting of one part).

Third year or first class.

1. Railways (consisting of one part).
2. Agricultural and urban hydraulics (consisting of one part).
3. Mechanics (consisting of two parts).
4. Metal bridges (consisting of one part).
5. Maritime works (consisting of one part).

In the majority of these projects in order to economize time and use it to the greatest advantage in the preparation of the project and in order to lighten the manual work of the students, sketches drawn to scale on cross-section paper are utilized as far as possible as a substitute for more elaborate forms of drafting. The sketches must be carefully made both as to the sketch itself and to the letters and figures. This system allows the greatest amount of time to be devoted to the study of the design and to the preparation of the memoir and it places the student in the true position of a designing engineer who is supposed to devote most of his time to the essential intellectual part of the preparation of his project and not to a great amount of manual labor. The work required in these projects is very considerable and the results submitted must be worked out in detail. They form a large measure in estimating the ability and standing of the students and they take the place of the ordinary examinations given in schools in this country.

The following are the projects or studies required of the students in the various classes for the year 1910–11, showing the subjects and the time allowed in the preparation of each:

FIRST CLASS.

Maritime work.—Project for a port upon a commercial route much frequented and destined to become quite an important port. Time, 4 weeks.

Railways.—Project of a single-track, standard-gauge railway. Time, 5 weeks.

Masonry bridge.—Project for a masonry bridge on a mountain road crossing a torrent. Time, 5 weeks.

Applied mechanics (reenforced concrete).—Three preliminary projects, from which two must be treated by at least 12 students—

(*a*) For widening viaduct for double track. Time, 6 weeks.
(*b*) For the establishment of a single-track viaduct. Time, 6 weeks.
(*c*) A minute examination of movements in the Eifel Tower. Time, 6 weeks.

Hydraulics, agricultural and urban.—Project for the water supply for a medium-sized city. Time, 6 weeks.

SECOND CLASS.

Architecture.—Project for a suburban office of a railway company. Time, 4 weeks.

Applied electricity.—Project for the electrical distribution on a waterway. Time, 6 weeks.

Masonry bridge.—Same as for first class. Time, 5 weeks.

Inland navigation.—Project for the upstream end of a canal lock with a metal gate. Time, 5 weeks.

Applied mechanics (reenforced concrete).—Three projects from which two optional ones must be taken by at least nine students—

(*a*) Project for the prolongation of a sea jetty.
(*b*) Project for the extension of a city pierhead.
(*c*) Project for the improvement of the deflection register. Time, 6 weeks.

THIRD CLASS.

Architecture.—Three sketches showing designs of the following works:

1. Public lavatory and fountain. Time, 3 weeks.
2. A bridge at the junction of two small rivers. Time, 2 weeks.
3. A small courthouse. Time, 3 weeks.

Applied mechanics.—

1. (*a*) Design of a cylindrical tube under various pressures; (*b*) design of a water reservoir. Time, 4 weeks.
2. (*a*) Design of a hyperstatic beam; (*b*) state of stability of an articulated system. Time, 6 weeks.

Highways and tramways.—Project for straightening out a highway. Time, 5 weeks.

(A complete set of the foregoing projects for the year 1910–11 is on file in the library of the United States Engineer School, No. 620.7 F815 P.)

PREPARATORY COURSE.

Architecture.—

3 washed drawings.
22 sketches.
3 projects.

Applied geometry.—

4 tests in descriptive geometry.
5 tests in stereotomy.
2 tests in graphical calculations.

Mechanics.—

1 study in graphical statics.

Laboratory work.—This includes the work in the chemical and physical laboratories similar to that required in an engineering course in this country and is of minor importance in an engineering school except for general information and for the preparation that the physical laboratory work gives for future electrical work.

The work with electrical machinery is conducted in the shops of the special school and in those of the school of mines which are well equipped and large enough for both schools. Each student has 12 days' work in these laboratories

The work of testing materials is done in the laboratory for that purpose attached to the national school and described later. It consists in helping prepare specimens and two days' work in testing with the machines.

Field work.—The program in the course of roads and railways includes a certain amount of practical work actually carried on in the field. This work includes the use of the chain, the square, the transit, the plane table, the level, and the tachometer. This field work involves taking the necessary notes and plotting them up later, and the computations involved therein.

TOURS OF INSTRUCTION.

From time to time during the year, and especially during the months of April and May, the students of the various classes take a few geological excursions and make numerous visits to engineering projects under construction, to important power plants, workshops, and engineering and industrial establishments that may have a bearing on or furnish instruction in connection with the various courses.

During the year 1910–11 the classes made the following visits:

FIRST CLASS.

To the agricultural exhibit and reservoir at Montsouris.
To the central power house of the Paris Electrical Co.
To the power house of the Metropolitan Railway, Paris.

To the power house of Weyher & Richemond at Pantin (boilers and steam engines).
To the power houses at Clichy and at Colombes and to the irrigation works at Gennevillieres.
To the filtration plant of Ivry and the departmental establishment at Montmesly.
To the springs of Loing and Lunain (water supply of Paris).
To the purification plant at Poissy, Carrieres, and Mery Pierrelaye.
The wireless-telegraph plant at Eiffel Tower and the military telegraph depot.

FIRST AND SECOND CLASSES TOGETHER.

To the port works at Dunkerque.
To the Creusot works.

FIRST, SECOND, AND THIRD CLASSES TOGETHER.

To the dam of Tuiliere at Arcachon and Bordeaux. (Electrical power plant, reenforced concrete construction, and port works at Bordeaux.)

SECOND CLASS.

Thirty-two sessions in the electric laboratory of the ponts et chaussees and 16 in the school of mines (12 manipulations for each student).
Two sessions in the laboratory for testing materials.
Visit to the lighthouse depot.

THIRD CLASS.

To the metal construction shops of Moisant, Laurent, Savey & Co., at Ivry.
To the reenforced concrete quay in course of construction at Auteuil.
To the Thomson-Houston Works at Vaugirard (electrical).
To the central power house of the Paris Electrical Co.
To the Auteuil loop of the Metropolitan Railway and to the Mirabeau Bridge, Paris.
To the plant of the French Cement Co. at Mantes.
To the plant of the Metropolitan Railway Co., Paris.
Work in the chemical laboratory.
Work in the laboratory for testing materials.
To the wooden pavement works of Paris and to the works of the Central Asphalt & Bitumen Co.
To the tunnels at Lausanne, Loetschberg, Simplon, and St. Maurice (electrical power houses).
To the steel works at Enville, Nancy, Pompey, and Gerardmer (includes a geological excursion).
A field survey on the island of Minimes.

PREPARATORY COURSE.

To the glass works of Legras & Co. at St. Denis.
To "La Monnaie" workshops.
To the gas works of the Heating & Lighting Co. at Gennevillieres.
To the mechanical museum at the Conservatory of Arts and Trades.
To the national pottery works at Sevres.

Missions.—From the 1st of June to the 15th of October during the first two summer vacations the French students are sent on missions of instruction to various parts of the country and are there attached to the public works in course of construction or to engineering or industrial establishments in order to obtain practical knowledge of such work under the supervision of the engineers in charge of the work. The particular object of these missions is the practical instruction received on the work and they form a sort of an apprenticeship in the functions of the engineer. The instructions given to the students before their departure require them, while paying particular attention to a study of the difficult problems of construction, to

endeavor to familiarize themselves with the accounts, returns, management, etc., and other administrative subjects. During the mission all students are required to keep a journal wherein they note points of information collected, their own observations of the work, and the operations in which they have taken part. This journal is considered in arranging the class standing both as to the merit of the journal itself and as to the zeal shown and the service rendered. A report of the engineer under whom they work is received to show how the students impressed the authorities over them.

Beginning with the summer 1911 the outside students of the second and third classes were informed that hereafter they must use their vacations in engineering occupation. The duties, travels, or visits that they followed during their vacations could be chosen according to their own personal wishes, and they could obtain positions furnishing a salary or not, but during their vacations they must be employed either with railroads, contractors on the public works, or in private establishments, power houses, or manufactories in such a way as to increase their engineering knowledge. In order to allow the school authorities to judge of the value of their experience they, like the engineer students, are required to submit a detailed memoir upon the employment of their time, accompanied by certificates of the engineers or contractors under whom they have worked, and all documents resulting from their observations or researches or personal work. Applications from outside students to visit the public works of the State on such missions will be recommended for approval by the school authorities.

Upon graduation certain selected graduates are sent on missions to foreign countries to study the great engineering works there under construction. This mission may last about a year. It is of great value to the young engineer in broadening his ideas and showing the widely different methods of handling similar works in different countries.

THE EXAMINATIONS.

The examinations are practically all oral and take place at the end of the school year independently of the projects, practical exercises, and missions that are required. They consist of an examination of the lecture notes kept and of an oral examination on the subject matter of the lecture courses given.

During the year students may be given partial examinations bearing upon the subject matter already covered. In the special school this would be done only under exceptional circumstances. There is ordinarily only one examination a year, and it comes at the end of the course. In the preparatory school, however, a partial examination is always given in January upon the subject matter studied in November and December in order to test the student's ability to continue in the course. A minimum of 7, or 35 per cent, is required in each of these partial examinations.

The annual examinations last from the 20th of March until the 31st of May in the special school and from the 15th of May to the 15th of June in the preparatory school.

Preparatory course.—The following table shows the course in the preparatory school and the weights assigned to the practical work, projects, examinations, etc.:

Subject.	Parts.	Weight.	Value.
Analytics	Practical exercises	6	120
	Examination	10	200
Mechanics	Practical problems	6	120
	Examinations	10	200
Applied chemistry	Practical application	4	80
	First examination	6	120
	Second examination	6	120
Physics	First examination	7	140
	Second examination	7	140
Chemistry	First examination	6	120
	Second examination	6	120
Architecture and technology.	Project	4	80
	Sketches	4	80
	Washed drawing	2	40
	First examination	2	40
	Second examination	2	40
German	Examination	2	40
English	do	2	40
Assiduity	To lectures and quizzes	5	100
	In the study rooms	3	60
Total		100	2,000

Each of the above separate parts is marked on a basis of 20, making the total possible mark 2,000, of which 1,300 is the minimum total for passing. In each of the subjects the student is required to obtain at least 7 on every part with the above-mentioned total average of 13. For attendance at lectures and quizzes the student must have 75 per cent.

Special course.—The following table shows the weights assigned to the various parts of the course in the different classes of the special course for the school year 1911–12. It shows the relative importance assigned to the examinations, projects, practical work, and notes taken while on missions.

Third class (first year).

Examinations.	Weights.	Value.
Applied mechanics (strength of materials)	10	200
Methods of construction	15	300
Highways and tramways	10	200
Applied electricity	10	200
Mineralogy and geology	10	200
Social economy	6	120
German	3	60
English	3	60
PROJECTS.		
Applied mechanics (strength of materials)	10	200
Highways and tramways	10	200
Architecture (3 sketches)	10	200
Materials of construction:		
Examination	8	160
Chemical laboratory	2	40
Mechanical tests	2	40
Topometry and measurement of earthwork:		
Examination	2	40
Work with wye level	3	60
Sketch of machines	5	100
Total weight [1]	119	2,380

[1] In accordance with the law one point is taken off for each unauthorized absence from a lecture, from a lesson in English or German, from a practical exercise or visit to an engineering work; and half a point for each absence from a session in the study rooms. A loss of 50 points, including all kinds of absences, or a loss of 25 points from lectures, etc., alone, entails exclusion from the school.

Second class (second year).

Examinations.	Weights.	Value.
Applied mechanics (hydraulics)	8	160
Metal bridges	7	140
Masonry bridges	7	140
Maritime work	12	240
Inland navigation	12	240
Railways	12	240
Administrative law [1]	10	200
Political economy and finances	10	200
German	3	60
English	3	60
PROJECTS.		
Architecture	10	200
Applied electricity	8	160
Masonry bridges	8	160
Railways	8	160
Applied mechanics (hydraulics)	8	160
Inland navigation	8	160
Sketches of machines	5	100
Electrical laboratory work	3	60
Notes while on mission	20	400
Total weight [2]	162	3,240

First class.

Examinations.	Weights.	Value.
Applied mechanics (hydraulics)	8	160
Steam engines and other thermal motors	15	300
Agricultural and urban hydraulics	10	200
Administrative law [1]	10	200
Political economy	10	200
Social economy	6	120
German	4	80
English	4	80
PROJECTS.		
Maritime work	8	160
Railways	8	160
Metal Bridges	8	160
Agricultural and urban hydraulics	10	200
Applied Mechanics (hydraulics)	8	160
Notes while on mission	20	400
Total weight [2]	129	2,580

[1] Optional for foreign students.

[2] In accordance with the law one point is taken off for each unauthorized absence from a lecture, from a lesson in English or German, from a practical exercise or visit to an engineering work; and half a point for each absence from a session in the study rooms. A loss of 50 points, including all kinds of absences, or a loss of 25 points from lectures, etc., alone, entails exclusion from the school.

NOTE.—The maximum mark on each of these subjects in all three of the above tables is 20 and the minimum 7, and the maximum and minimum total for each subject is its weight multiplied by 20 and 7, respectively. A general mean average of 65 per cent is required at all times.

Methods of marking.—Each examination, project, or practical exercise is marked on a basis of 20, and 7 is the minimum passing mark. In case a mark of less than 7 is received that practical test must be done over. The final mark on the test in which the student failed the first time can only be increased on a second trial by the amount that the new mark exceeds 10; thus if a student receives a mark of 5 on the first test he must take it over and, in case he received 12 on the second test, his first mark is increased by 12 minus 10, making his resulting mark for that test 7.

The general average at the end of any year for all such tests previously given must be at least 13, or 65 per cent, in order for the

student to be promoted from one class to another or to graduate This percentage must be the resulting average for the previous actual marks, minus whatever penalty there may be for unauthorized absences.

This minimum average is mandatory under pain of exclusion from school unless the school board authorizes the student to be turned back to the following class.

No system of daily marks is kept except the record of attendance. There are no daily or other recitations, the standing and marks depending on the examinations, projects, mission journals, and practical work.

CLASS STANDING AND GRADUATION STANDING.

The standing of the various students in the class is fixed at each promotion and at the end of the course by the school board. This classification is entirely separate for engineer students and for outside students.

The class rank is determined by the total number of points obtained in the examinations, practical exercises, projects, and missions (including penalties for unauthorized absences from lectures, etc.), not only during the current year but also during the preceding years in the special course according to the conditions laid down by the ministerial decree. The points obtained in each subject are the product of the mark received multiplied by the weight assigned to the subject. These weights are shown in the preceding tables and are determined according to the importance of the subject by the school board.

The passage of students from one class to another and the graduation from the school can not take place unless they have satisfied for the year or for the course all the conditions fixed by the ministerial decree.

In case of sickness or other grave and exceptional circumstances having occasioned a forced suspension of work, the minister may, upon the recommendation of the school board, authorize the student to take his year's work over.

A conductor or subengineer failing to pass the course in the national school is allowed to go back to his place as a conductor or subengineer with the rank that he would have held had he remained continuously in his position.

Proficiency.—No student is allowed to pass from one year to another, nor to graduate unless his total average is 65 per cent and he shall have acquired at least 50 per cent of the total marks in each year; and the outside students can not receive the diploma of engineer of civil constructions and the engineer students can not be nominated for the grade of ordinary engineer of the third class unless they shall have obtained 65 per cent of the total of all points that can be obtained in the entire course at the school.

For the first year the student's average must be 65 per cent. During the second year his average may fall to 50 per cent on the subject matter of that year, but his average for the first and second years must be 65 per cent.

Similarly, for the third year the student's average on the subjects of that year may fall to 50 per cent, but his general average for the entire course must be 65 per cent.

PROMOTION OF ENGINEER STUDENTS ON GRADUATION.

The engineer students, having completed their course of studies in accordance with the regulations of the school, are appointed ordinary engineers of the third class, with a yearly salary of $1,000 plus certain perquisites and allowances which vary from $200 to $800, depending upon the importance of the work.

The engineer students promoted to engineers choose their work and station from among those open to choice in the order of their class standing, with the single proviso that they are not allowed to choose for their first station any place in the department where any of their family resides.

Outside students are neither required nor allowed to enter the public service as a result of graduation alone. The fact that the tuition is gratuitous involves no after service to the State.

BOOKS.

Several of the courses taught in the Ecole des Corps des Ponts et Chaussees have been published and are on public sale. These courses pertain principally to subjects in which the changes are few and infrequent and where the text has been tested by several years use in the school. The majority of the courses in the school do not exist in printed form but are prepared by the professors of the school and are issued in lithograph sheets from the lithograph department of the school. These lithograph copies are distributed free to the students and contain the gist of the subject matter given in the lectures of the corresponding course. They contain the subject matter of the lectures that would be printed in book form together with the necessary illustrations, and they form the ground work for the professors' lectures on those subjects. In the lectures themselves they are amplified and supplemented by more detailed explanations and descriptions by the professor himself. Sometimes these notes are prepared by the professor and sometimes by the students themselves, and even in the latter case they are always a very valuable collection of notes to preserve and fix a true summary of the course of instruction. A complete set of these lithographed courses is on file in the library of the United States Engineer School. (See list of publications in library of United States Engineer School.)

DIPLOMA.

The higher diploma of engineer of civil constructions is delivered by the minister to such outside students, both French and foreign, as have satisfied all the conditions of the ministerial decree and who have obtained at least 65 per cent of the total number of points which can be acquired in the course of instruction in the special school.

Those who have merely satisfied the conditions of the ministerial decree heretofore mentioned receive from the director only a certificate of the studies pursued upon which is noted the marks obtained on the various subjects in the examination and practical exercises.

Disciplinary measures.—Aside from private reprimands to which students may be subjected, the punishments applicable in case of necessity are the following:

1. Temporary suspension from the school.
2. Reprimand in school orders.
3. Reprimand by the school board with or without publication in orders.
4. Suspension from advancement with the class.
5. Dismissal from the school.

The spirit of order and discipline in the school is so high that these various measures seldom come into operation except the delay in advancement from class to class accorded or imposed at long intervals in the interest of the student or of the school.

Temporary expulsion from the halls of study and temporary expulsion from school itself can be inflicted by the director or by the inspector. The duration of this punishment must not exceed 15 days when imposed by the director, nor 8 days when imposed by the inspector. Every such exclusion of more than 10 days is reported to the minister. The application of any of these punishments does not relieve the student in any way from the obligations which he must fulfill in order to pass to the next higher class at the end of the session.

The reprimand in orders can be given in the cases provided by the regulations by the inspector, the director, the school board, or the minister, depending upon the gravity of the offense. Censure or reprimand is given to the student in the presence of the school board, and the board decides whether or not it shall be published in the orders of the school.

Delay in advancement from one class to another is made by decisions of the minister upon the recommendation of the school board.

Dismissal from the school is pronounced, upon the recommendation of the school board, by presidential decree in the case of engineer students, and by the minister in the case of outside students.

In all cases involving dismissal from the school, the student concerned is always allowed to present his defense to the school board before final action is taken.

THE MILITARY SERVICE OF STUDENTS.

Article 21 of the law of March 21, 1905, provides that in time of peace reprieves from service, renewable from year to year up to the age of 25, can be given to young men who make application therefor in the interest of their studies, and also provides that students of the Ecole des Ponts et Chaussees may either serve the first of their two years in some unit under ordinary conditions before their entrance into the school or after their graduation therefrom.

Young men who at the time they enter the preparatory school are 18 years of age and are recognized as suitable for the army must enter into a voluntary enlistment between October 1 and 10 of that year for six years. Such of these as desire to perform their military service after the completion of their school work must make declaration to that effect in writing, at the time of their enlistment.

Such of them as have not yet reached the age of 18, and those who have not been recognized as suitable for the army at the time of their entrance into the school, must make the enlistment for six years, either on their eighteenth birthday or whenever they may be recog-

nized as fit for the service. The beginning of this enlistment is counted from their admission to the school. The instructions of August 25, 1906, stipulate that students of the school will perform their service after completion of their studies, but they may request to be excused from the incorporation as provided in article 21 of the law of 1905. All outside students, except those who are physically unfit and those who go in the auxiliary service, receive certain military instruction in the school to prepare them for the grade of sublieutenant in the reserves. Those who at the time of their graduation have passed the examinations required in this grade, and who have completed one year's service before their entrance to the school, immediately complete their second year in the position of sublieutenant of the reserves. Those who have delayed both their two years of service until after their graduation, and who have satisfactorily passed the examination in the military subjects, serve one year under ordinary conditions and the second year either as sublieutenants of the reserves or as sublieutenants in the active army. Finally, those students who have not satisfactorily passed the graduating examinations in the school—that is, those who have not obtained the diploma of engineer of civil constructions and those who have left the school for any reason whatever without completing the course—are incorporated in the army as private soldiers or noncommissioned officers and complete their one or two years' service, depending upon whether or not they performed one year of service before their entrance into the school.

In these last-mentioned cases the enlistment which they have contracted is annulled.

MILITARY INSTRUCTION.

The law requires that a certain amount of military instruction be given to the French students. This is usually given by officers of the engineers of the French Army and covers the matter prescribed by law.

The course was not a very important one and its omission has been recommended. It is shown in detail in the Program of Interior Instruction heretofore mentioned.

INDUCEMENT TO HARD STUDY.

Prizes.—Certain Government prizes in the scientific subjects, with a value that may reach $40, are accorded annually in each subject to such projects and memoirs as may be judged worthy of this recompense by a board formed from members of the council of improvement. Under these provisions, in 1910 $700 was distributed by the council of improvement among the students of the school, and in addition $170 in prizes was awarded for excellence in the students' reports on their missions.

In addition to the foregoing Government prizes, the following prizes are given during the year:

Reynaud prize.—Treatise on architecture, to the two most distinguished students in architecture during the three years' course.

The Tarbe de St. Hardouin prize.—Forty dollars in scientific works, to the graduating student most distinguised in administrative law.

Alfred Durand-Claye prize.—A copy of course in hydraulics by M. Durand-Claye and M. F. Launay, to the two students most distinguished in hydraulics.

The Alfred Picard prize.—Ten copies of L'Bilan d'un Siecle.

The Henry Giffard scholarship.—Described later under "Assistance to poor students."

The Eugene Timonoff prize.—Forty-five dollars, to the outside student, French or foreign, who throughout the entire course of his studies has obtained the highest mark in accordance with the rules and regulations of the school.

ASSISTANCE TO POOR STUDENTS.

There is a fund called the Henry Giffard fund, which produces two scholarships each year with a value of $240 each. These are intended for deserving students in their second and third years in the special school. One of these scholarships is given every year to a student just completing his first year and continues during the remaining two years of the course. In order to become eligible for it a student must apply to the director of the school before the 1st of December in his first year in the special school, and must accompany his application with a full statement showing the financial circumstances of his family.

The scholarship can only be awarded to one whose class standing at the end of the year is at a mean general average of 65 per cent or more. These applications are transmitted to the minister, who awards the scholarship to the most deserving student. In making award of the scholarship the zeal and application are taken into consideration. The scholarship begins the first of the following July.

Time assigned to various subjects.—The hours assigned to the lecture-room work of each class in both the preparatory and the special schools are shown in the following tables:

Preparatory course.

[Hours at which lectures start: Nov. 3, 1911, to May 15, 1912.]

Course.	Number of lectures.	Professor.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
Analytics and mechanics	20 22	Maillet	.....	.....	.....	2	.....	2.30
Applied geometry	31	d'Ocagne	10	.....	1.30	.....	.....	.....
Architecture	30	Pillet	.....	3.15	.....	.....	3.30	.....
Physics	40	Mesnager	.....	1.30	.....	.....	1.30	.....
Chemistry	30	Etienne	.....	.....	8.30	.....	.....	8.30
Quizzes in analytics and mechanics.	15 17	.....	3	.....	.....	3.30	.....	.....
German	20	Mathis	.....	.....	.....	10	.....	.....
English	20	Garnier	.....	9	.....	.....	.....	.....
Military instruction	39	Chambeau	.....	10.15	.....	.....	10.15	.....

The lectures begin promptly at the hour indicated. Students must be in the lecture room five minutes in advance of the hour.

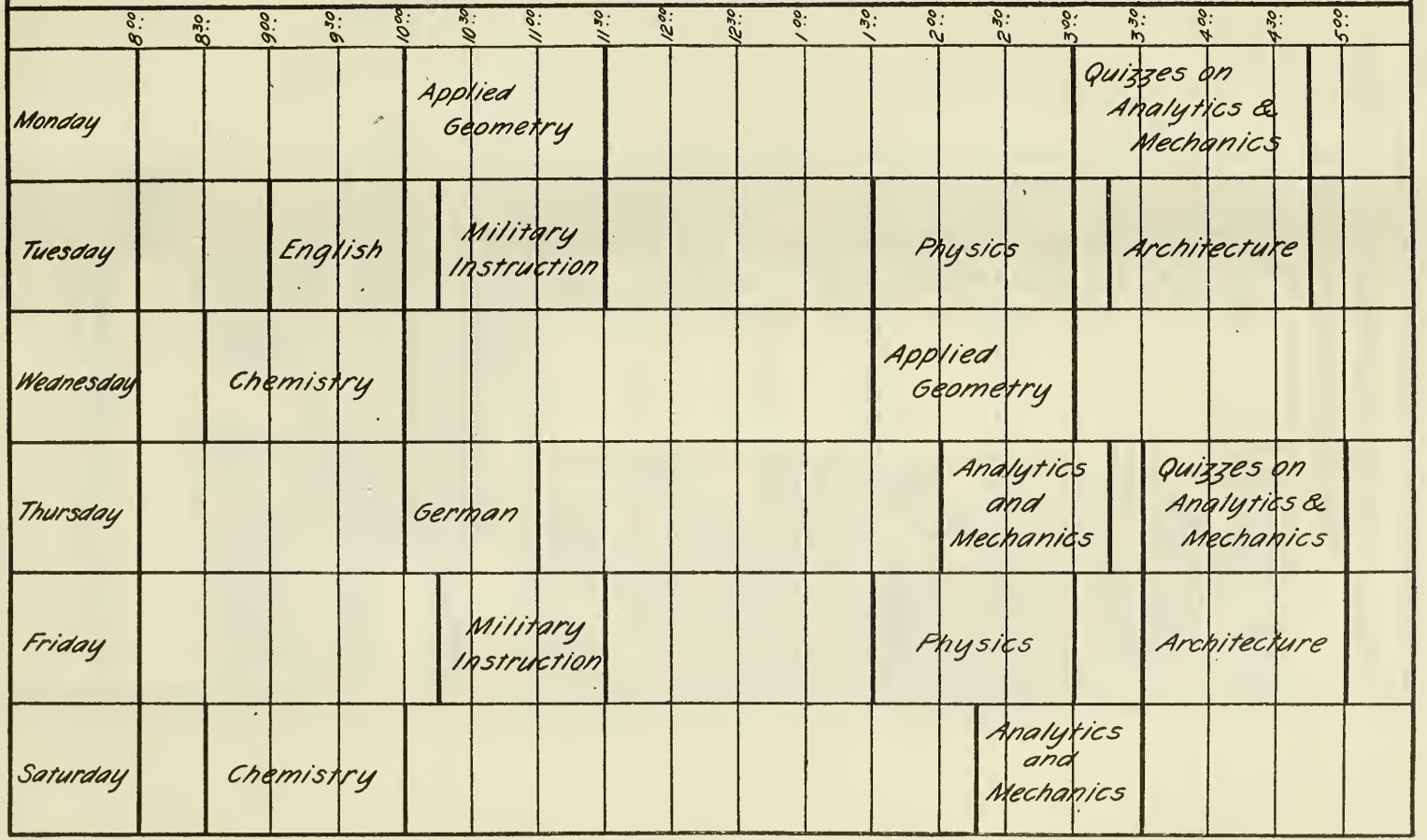
L'ÉCOLE NATIONALE DES PONTS ET CHAUSSÉES, NO. 28 RUE DES SAINTS-PÉRES, PARIS, FRANCE.

PREPAROTORY COURSE, ECOLE DES PONTS AT CHAUSSÉES—PARIS, FRANCE.

Table Showing Disposition Of Time During The Week.

School Year Nov. 3, 1911 to May 1, 1912.

Session 1911-1912.



1st CLASS COURSE COURSE FOR 1911-1912.
Course opens ce opens Oct. 16, 1911.

	8 30	9 00	9 30	10 00	10 30	11 00	11 30	1 00	1 30	2 00	2 30	3 00	3 30	4 00	4 30	5 00
Monday								P ...nways & ...tramways		P Mineralogy & Geology			Military Instruction P Ext.			
Tuesday		M Political Economy			M English Ext.			P ...erials of ...onstruction								
Wednesday								P ...plied ...echanics P		P Mineralogy & Geology			P English Eng.	P English Ext.		
Thursday		P German Ext.			M Administrative Law			P ...nways & ...tramways		M German Ext.						
Friday		M Political Economy			M German Eng.			P ...erials of ...onstruction		Sketches of Machines						
Saturday		G Applied Mechanics Hydraulics				M English Eng.		P ...plied ...echanics P			G German Eng.			G Social Economy		

PROJECTS & ...of materials.
ADDITIONAL SESSIONS
Maritime Works ...es for determination of rocks & fossils.
Railways ...emical Laboratory Work (in March)
Metal Bridges ...sting material (in April)
Applied Mechanics (Hydraulics ...upon diaries of missions.
2 studies ...eld work & surveying (after end of
Hydraulics, agricultural & urb... lectures & projects.)
Tours of Inspection

...OJECTS & STUDIES

...ral Sketches	Nov. 3rd to Dec. 23rd
(1st study)	Jan. 3rd to Jan. 31st
(2nd study)	Jan. 31st to Feb. 26th
Tramways	Feb. 26th to March 30th
...pection	April and May.

Note: M, G, P } Lecture Rooms
Eng. — Engineer Student...
Ext. — Outside Student...

...d hour for lectures in Topometry
...arth work will be announced

1st CLASS COURSE FOR 1911-1912.
Course opens Oct. 16, 1911.

	8:30–9:00	9:00–9:30	9:30–10:00	10:00–10:30	10:30–11:00	11:00–11:30	1:30–2:00	2:00–2:30	2:30–3:00	3:30–4:00	4:00–4:30	4:30–5:00
Monday							M Administrative Law			G Steam Engines		
Tuesday		M Political Economy			M English Ext.							
Wednesday							M Applied Mechanics Hydraulics			Military Instruction Ext. G		
Thursday		P German Ext.		M Administrative Law			G Hydraulics Urban & Agricultural			G Steam Engines		
Friday		M Political Economy			M German Eng.							
Saturday		G Applied Mechanics Hydraulics			M English Eng.		M Hydraulics Urban & Agricultural			G Social Economy		

PROJECTS & STUDIES

Maritime Works	October 16th to Nov. 20th
Railways	Nov. 20th to Dec. 20th
Metal Bridges	Dec. 20th to Jan. 22nd
Applied Mechanics (Hydraulics) 2 studies	Jan. 22nd to Feb. 26th
Hydraulics, agricultural & urban	Feb. 26th to March 25th
Tours of Inspection	April and May.

Note: M, G, P } Lecture Rooms
Eng. — Engineer Students
Ext. — Outside Students

2nd CLASS COURSE FOR 1911-1912.
Course opens Oct. 16, 1911.

	8:30–9:00	9:00–9:30	9:30–10:00	10:00–10:30	10:30–11:00	11:00–11:30	11:30–12:00	1:30–2:00	2:00–2:30	2:30–3:00	3:30–4:00	4:00–4:30	4:30–5:00	5:00–5:30
Monday		M Railways			A				G Administrative Law		M German Eng.	M German Ext.		
Tuesday		M Political Economy			A				G Masonry Bridges		P Metal Bridges			
Wednesday		G Administrative Law			A				G Maritime Works		M Inland Navigation			
Thursday		M Railways			A				G Applied Mechanics Hydraulics		P English Eng.	Military Inst. Ext. M	English Ext. P	
Friday		M Political Economy			A				G Masonry Bridges		P Metal Bridges			
Saturday		G Applied Mechanics Hydraulics			A				G Maritime Works		M Inland Navigation			

ADDITIONAL SESSIONS

A - 12 Sessions of Electrical Laboratory Work (Oct. 16th to Dec. 4th) at 10 00 a.m.
4 Sessions at handling machinery.

PROJECTS & STUDIES

Architecture	Oct. 16th to Nov. 20th
Applied Electricity	Nov. 20th to Dec. 20th
Masonry Bridges	Dec. 20 to Jan. 22nd
Railways	Jan. 22nd to Feb. 26th
Applied Mechanics (Hydraulics) 2 studies	Feb. 26th to March 25th
Inland Navigation	March 25 to April 20th
Tours of Inspection	April and May.

3rd CLASS COURSE FOR 1911-1912.
Course opens Oct. 16, 1911.

	8:30–9:00	9:00–9:30	9:30–10:00	10:00–10:30	10:30–11:00	11:00–11:30	1:30–2:00	2:00–2:30	2:30–3:00	3:30–4:00	4:00–4:30	4:30–5:00
Monday		G Applied Electricity			P Highways & Tramways				P Mineralogy & Geology		Military Instruction P Ext.	
Tuesday		G General Methods of Construction			P Materials of construction							
Wednesday		M Architecture			★ Applied Mechanics P				P Mineralogy & Geology		P English Eng.	P English Ext.
Thursday		G Applied Electricity			P Highways & Tramways				M German Ext.			
Friday		G General Method of Construction			P Materials of Construction					Sketches of Machines		
Saturday		★ Applied Mechanics P							G German Eng.		G Social Economy	

★ Strength of materials.

ADDITIONAL SESSIONS

5 Conferences for determination of rocks & fossils.
4 Days of Chemical Laboratory Work (in March)
1 Day for testing material (in April)
1 Conference upon diaries of missions.
3 Days of field work & surveying (after end of lectures & projects.)

PROJECTS & STUDIES

3 Architectural Sketches	Nov. 3rd to Dec. 23rd
Mechanics (1st study)	Jan. 3rd to Jan. 31st
Mechanics (2nd study)	Jan. 31st to Feb. 26th
Highways & Tramways	Feb. 26th to March 30th
Tours of Inspection	April and May.

Note:
Day and hour for lectures in Topometry and Earth work will be announced later.

(To face p. 36.)

GSOC3—13.

Special course.

Hours at which lectures start: First and second classes, Oct. 16, 1911, to Apr., 1912; third class, Nov. 3, 1911, to Apr., 1912.]

Course.	Number of lectures.	Professor.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Lecture room.
FIRST CLASS.									
Social economy	20	Gide						3.30	G.
Applied mechanics, hydraulics, steam engines, and other thermal motors.	20	Rabut				1.30		8.30	G.
	34	Walckenaer	3.30			3.30			G.
Agricultural and urban hydraulics.	32	Bechmann			1.30			1.30	M.
Political economy and finances	36	Colson		8.30			8.30		M.
Administrative law	39	Chareyre	1.30			10			M.
German:									
Engineer students	20	Mathis					10		M.
Outside students	20	Mathis				8.45			P.
English:									
Engineer students	20	Garnier						10.30	M.
Outside students	20	Garnier		10					M.
Military instruction (outside students).	18	Chambeau			3.15				G.
SECOND CLASS.									
Applied mechanics (hydraulics)	20	Rabut				1.30		8.30	G.
Metal bridges	16	Resal		3.30			3.30		P.
Masonry bridges	22	Séjourné		1.30			1.30		G.
Maritime works	35	de Joly			1.30			1.30	G.
Inland navigation	35	Dúsuzeau			3.30			3.30	M.
Railways	33	Fouan	8.30			8.30			M.
Political economy and finance	36	Colson		8.30			8.30		M.
Administrative law	40	Romieu	1.30		8.30				G.
German:									
Engineer students	20	Mathis	3						M.
Outside students	20	Mathis	4						M.
English:									
Engineer students	20	Garnier				3.30			P.
Outside students	20	Garnier				4.30			M.
Military instruction	19	Chambeau				3.15			M.
Electrical laboratory	12	Picou							
THIRD CLASS.									
Applied mechanics (strength of materials).	36	Resal			10.15			10.15	P.
Materials of construction	24	Mesnager		10.15			10.15		P.
Methods of construction	30	Felix Launay		8.30			8.30		G.
Highways and tramways	26	Heude	10.15			10.15			P.
Topometry and earthwork [1]	10	d'Ocagne							G.
Applied electricity	32	Guillebot de Nerville.	8.30			8.30			G.
	9	Picou							
Mineralogy and geology	30	De Launay	1.30		1.30				P.
Social economy	20	Gide						3.30	G.
Architecture	17	Bonnet			8.30				M.
Sketches of machines	12	Pillet					1.30		
German:									
Engineer students	20	Mathis						2.15	G.
Outside students	20	Mathis				1.30			M.
English:									
Engineer students	20	Garnier			3				P.
Outside students	20	Garnier			4				P.
Military instruction	20	Chambeau	3.15						P.

[1] The day and the hour will be given later.

THE LIBRARY.

The school possesses a library in which is found an exceedingly valuable collection of works pertaining to the science of engineering. The origin of this library is coeval with the school, but the library was not really formed as such until the Revolution, when the National Assembly decreed that all the valuable scientific and literary collections of the religious establishments which had been suppressed

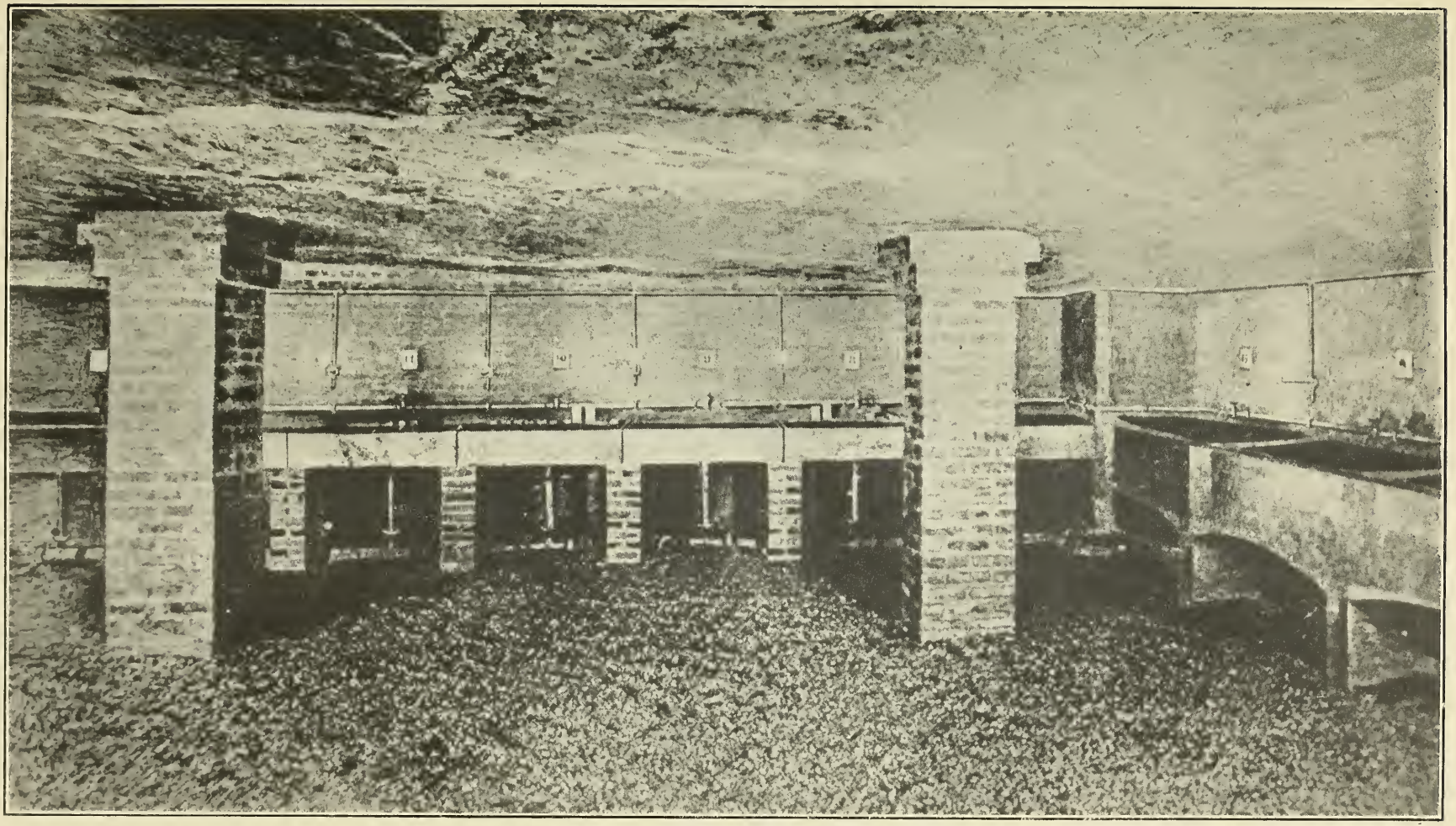
should be distributed among the larger institutions of learning of France. The Ecole des Ponts et Chaussees was included among these institutions and received its share of the collections. To this, as a nucleus, has been added from time to time the library of the founder of the school, Perronet, in 1793; that of the inspector of studies, Le Sage, in 1810; and that of the director of the school, Baron de Prony, in 1839. The library of the school to-day embraces about 100,000 volumes and its archives contain about 10,000 manuscripts, many of which are exceedingly rare and valuable. The library subscribes to 140 periodicals, both French and foreign.

Catalogues.—Three catalogues of the library have been printed and are distributed to all the engineers in the active service of the corps des ponts et chaussees, permitting them to grasp with very little work the entire bibliography on any subject that is available in this large library, which gives them an almost complete bibliography on any engineering subject. The library includes technical works of value, remarkably complete, of both ancient and modern writers. Engineers of the service are, in addition, kept up to date as to the new accessions of the library by an accession list published bimonthly in the Annales des Ponts et Chaussees. The advantage of this publicity regarding the contents of the library is made additionally valuable by the regulation which permits any engineer to draw from the library for his use anything that he may desire, with a few exceptions which are made in regard to exceedingly rare or valuable works which are not allowed to leave the library. This permits the engineers of the service to obtain for their use literature on practically any subject that may arise in the course of their work. Over 2,000 volumes are thus sent out annually for use in connection with the public works. A copy of this catalogue was obtained and is now on file in the library of the United States Engineer School, No. 016.620 P232. E. F., 3 volumes.

Gallery of models.—The school is liberally supplied with models of existing engineering structures and with scientific collections of various kinds. These are kept in the halls of the school, where they can be readily inspected and studied by the students, and form a valuable adjunct to the course of instruction as illustrating lectures in the engineering and scientific courses. The engineering models are constructed to a convenient scale and many of them can be operated and taken apart for the information and instruction of the students. In addition to these models there are a great number of plans of works which, studied in connection with the models and the lecture notes, are of great value to the students in the preparation of their projects. The following collections constitute the museum of models, scientific collections, and apparatus pertaining to the school:

1. A mineralogical collection.
2. A collection of materials of construction.
3. A collection of surveying instruments.
4. A collection of models and designs of certain public works.
5. A laboratory of electricity for practical exercises.
6. A collection of physical and chemical apparatus for use in the preparatory course.

Laboratories.—The laboratories in connection with the school are in two parts. The chemical, physical, and electrical laboratories are



VIEW OF UNDERGROUND CHAMBER USED FOR PRESERVING BRIQUETS OF LIME AND CEMENT.

installed in the school building proper; and the laboratory for the physical and mechanical tests occupies a separate building in another part of Paris. The chemical laboratory is a satisfactory one and is sufficient for the amount of chemical knowledge required in a civil engineering course. The electrical and physical laboratories are small, but are well equipped and are sufficient for an engineering course when taken in connection with the electrical shops and laboratory of the School of Mines. The laboratory for mechanical tests is an establishment well equipped and adapted for its use in connection with an engineering school of the highest order. The principal apparatus and appliances to be found in this laboratory are as follows:

For compression tests:
- One hydraulic press of 14 tons.
- One Amsler Lafont press of 30 tons.
- One hydraulic press of 80 tons.
- One hydraulic press of 400 tons.

For tests in tension, bending, and torsion:
- One Perreaux machine for tension, 1 ton.
- One Amsler Lafont machine for torsion of wires.
- One Falcot machine, 60 tons. This machine is arranged for compression tests upon bridge members.
- One machine for bending, sheering, or tension up to 10 tons on test specimens of stone.
- One bending apparatus for bending tests.

For tests by shock or blow:
- One small pile driver with free fall, metallic balls of from 250 to 500 grams.
- One pile driver with a hammer 4½ kilograms.
- One double Fremont pile driver with a 10-kilogram hammer.
- One Charpy pendulum hammer with a weight of 50 kilograms.

For wear and tear tests and for miscellaneous tests:
- One Dorry machine for wear and tear tests by rubbing upon a sanded surface.
- One Deval machine for tests by moderate shocks and the reciprocal wearing of masonry materials one upon another (rattler).
- One ice-making machine for freezing tests.
- One Brinell apparatus for determining the hardness of materials by measuring the impression of a ball under load.
- One machine for endurance tests.
- One Schone apparatus for pulverizing tests.

For tests of tubes under interior pressure:
- This machine can receive tubes 80 centimeters in length and 45 centimeters exterior diameter (sewer pipe, etc.).

For tests of lime and cements according to the international specifications.
- One Michaelis apparatus.
- One Le Chatelier apparatus for measuring expansion.

For measuring interior strains in transparent materials:
- One polarized light machine (Jobin) especially arranged for this purpose.

For microscopic investigations:
- One Le Chatelier microscope arranged for photographic use and the necessary accessories for polishing.

For the study of spring waters:
- One constant-temperature drying oven for the study of microbe colonies contained in water, and one sterilizer.

The laboratories of the school receive annually more than 800 requests for tests corresponding to the handling of from 1,800 to 1,900 specimens and requiring more than 45,000 determinations. Their activity and scope is limited to tests which have some connection either with the public works or with the potable water supply of cities. Among these tests, those which are made for contractors or manufacturers of products for use on such works are charged for at rates which are fixed by the decree of June 3, 1902. A full description of these

laboratories, together with illustrations, is given in the "Laboratories de l'Ecole Nationale des Ponts et Chaussees," on file in the library of the United States Engineer School, No. 620.11 D 288.

ELECTRICAL LABORATORY.

In 1910 arrangements were made by which the greater part of the practical electrical work is done in the electrical shops and laboratory of the National School of Mines.

PUBLICATIONS.

The official publication of the corps des ponts et chaussees is its "annales." While the Annales des Ponts et Chaussees is not, strictly speaking, a school publication, yet it is published in connection therewith, and the publishing committee has its headquarters in the school. The journal itself is too well known to need any description or praise. It is the official organ of the corps, and its object is to publish memoirs and documents relating to the art of construction and to the service of engineering. It is published in two parts, the technical and the administrative part. The administrative part contains all laws and decrees affecting the corps either as to the personnel or its work. The technical part is devoted to scientific and other engineering matters of general interest to engineers and of special interest to the corps des ponts et chaussees. It is published bimonthly by a commission composed of the following officials of the public works department:

Director of the Ecole des Ponts et Chaussees.
Inspector of the Ecole des Ponts et Chaussees.
Director of personnel and accounts.
Director of highways and navigation.
Director of railways.
Director of mines.
Eleven inspectors general of the corps des ponts et chaussees.
All the professors belonging to the corps des ponts et chaussees in the Ecole des Ponts et Chaussees.

The director of the Ecole des Ponts et Chaussees is president of the commission, and the secretary of the school is its secretary. Two engineers of the corps des ponts et chaussees act as assistant secretaries.

BUILDINGS.

The school is located in an old building at No. 28 Rue des Saints Peres, Paris, France, with its laboratories for testing materials in a separate group of buidilngs at No. 3 Avenue D'Jena.

The main building of the school is at least 150 years old and can hardly be said to be a suitable structure for so celebrated and distinguished a school as the one that occupies it. It formerly belonged to the Fluery family of France and was confiscated as the property of an emigré at the time of the Revolution. It has been occupied by the school since 1845, and although it has been changed considerably in its interior arrangement it is much the kind of building that usually results from adapting an old residence to the needs of a school.

The building is not fireproof and in case of fire it would be practically impossible to save the exceedingly valuable library which is located on the third floor and in the attic. The library, especially, is handicapped not only as regards safety but also by lack of room and the necessity of storing so many of its books in the attic.

Floor plans of the building accompany this report and show the distribution of space.

The laboratory for testing materials is located at No. 3 Avenue D'Jena. The buildings were built in 1867, and although the buildings are in excellent condition yet they are hardly large enough for the purposes intended. This laboratory is constructed on the site of an old quarry in which an underground room was discovered so far below the surface that the temperature is practically constant winter and summer. This cave has formed an excellent part of the laboratory, as specimens for test, especially limes, cements, etc., can be kept at a uniform temperature at practically no cost. The temperature can be kept constant by simply lighting a few gas jets in the cold weather.

Plans of the building accompany this report and show the distribution of space and the use to which the various parts are assigned.

CENTRAL DEPOT OF INSTRUMENTS OF PRECISION.

This branch of the service of the school embraces the purchase, repair, receipt, and test of all instruments, apparatus, or machines, approved by ministerial decision for the engineers of the ponts et chaussees in France and the colonies. In addition to that, it is charged with issuing to these engineers on memorandum receipt such measuring or observing apparatus as may be necessary in the tests of engineering structures. Moreover, here are received and kept in stock all the instruments and apparatus from engineers in the service who have no longer any use for them. Here they go over them and put them in good condition and issue them again to the service whenever and wherever they may be needed. Furthermore, the engineers of the departmental services and of the other public departments, such as the railways, colonies, etc., frequently have recourse to this bureau for the testing and regulating of apparatus which they have acquired directly. It will be seen from the foregoing that this central depot corresponds in many ways to the engineer depot of the Corps of Engineers at Washington Barracks, D. C.

THE DEPOT OF MAPS AND PLANS.

This depot is divided into two sections, the photographic and lithographic laboratory and the bureau of draftsmen.

Photographic and lithographic laboratory.—This laboratory was created about 1870 in order to meet the demands of the depots and of the school and to teach the students the practical work of photography. It has been very considerably extended in recent years, due to the improvements made in its location and equipment, and its usefulness continues, although photography is no longer taught in the course.

Bureau of draftsmen.—This bureau, whose origin dates back before the creation of the school, assists directly in the work of the school by preparing all the designs necessary to the demonstrations for lectures

and also in the publication of the lithographed courses. Whenever necessary it is used in preparing for publication the various techincal documents and maps pertaining to the administration of the public works. These documents and maps consist of the following:

1. The outlines of the navigable waterways of France.
2. The map of France, scale 1 to 200,000.
3. The outlines of the maritime ports of France.

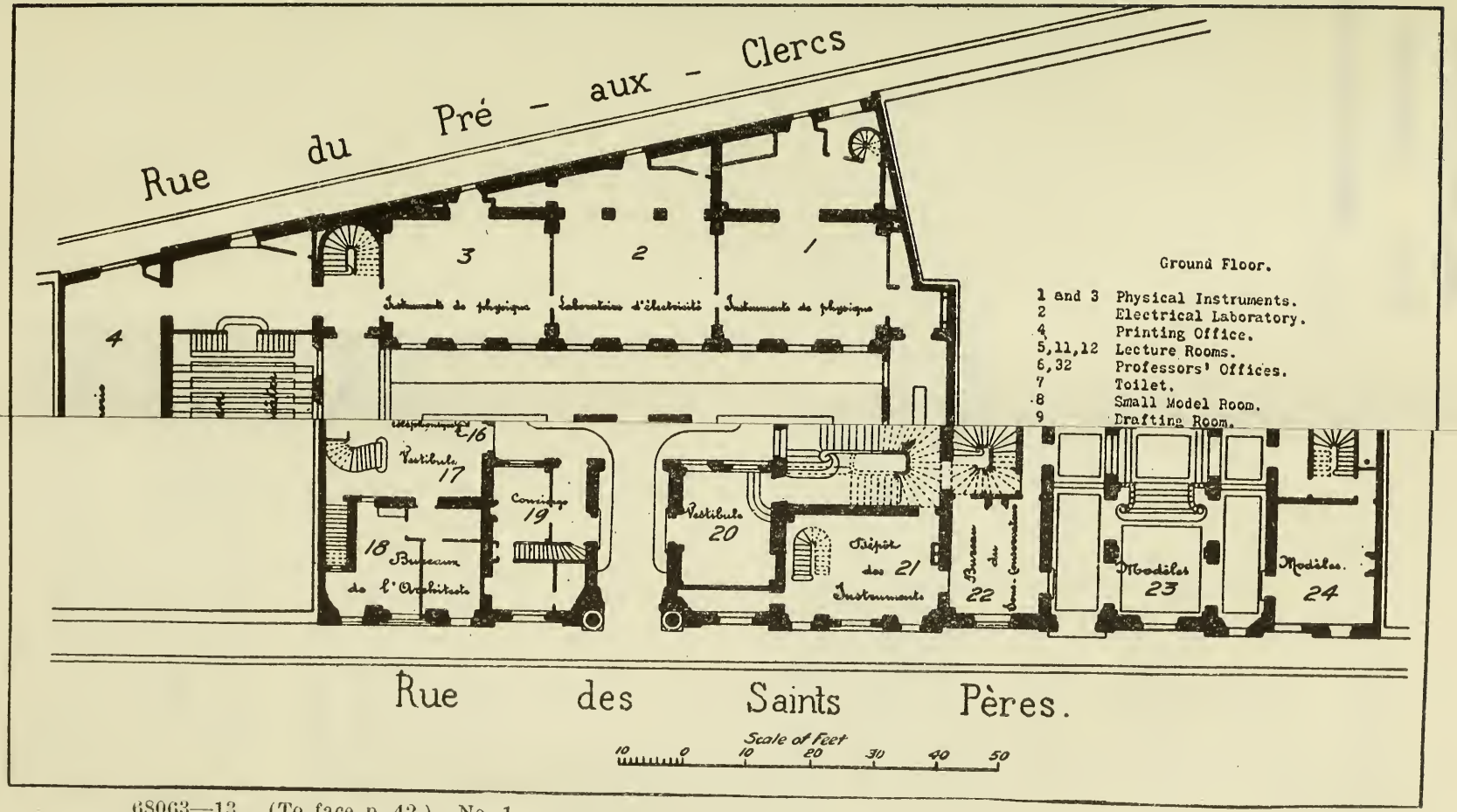
In addition to the drawings which are required of them by the various services of the school, the bureau of draftsmen has also in its charge:

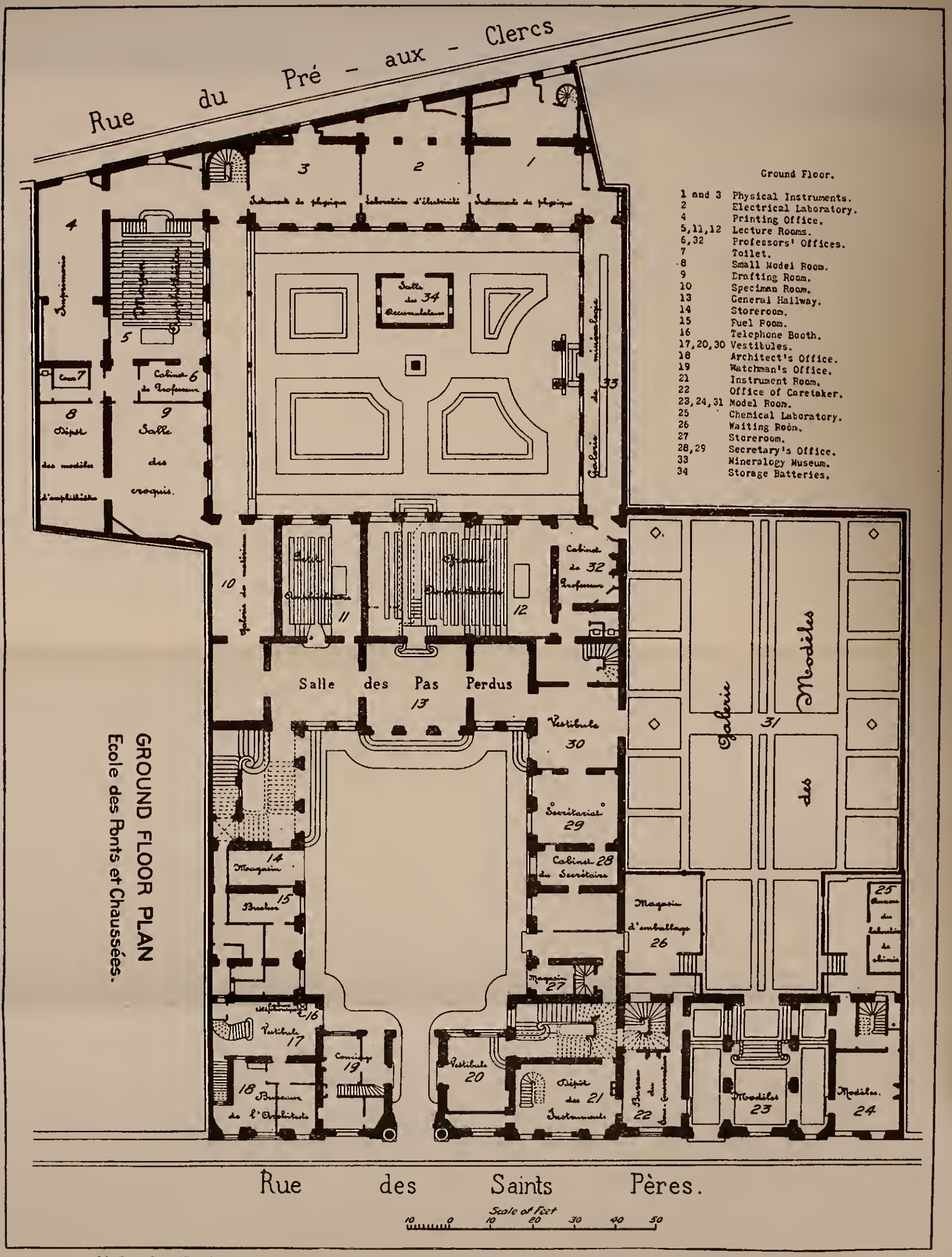
1. The issue of drawings required by the current needs of the headquarters of the department of public works (copies of maps, graphical diagrams, etc.).
2. The collection of documents concerning the railways newly opened to traffic.
3. The corrections and changes in the map showing the ways of communication (scale 1 to 500,000) and the navigable waterways chart (scale 1 to 1,250,000).
4. The corrections and changes in the maps showing the outlines of the ports of France.
5. The preparation of special drawings or plans for the engineer service that may be necessary for making a study of the works.

LIST OF PUBLICATIONS OBTAINED.

The following publications pertaining to the Ecole Nationale des Ponts et Chaussees and the courses taught therein were obtained and are on file in the Library of the United States Engineer School:

1. Program of Conditions for Admission to the Ecole Nationale des Ponts et Chaussees. No. 620.7 F815 E1.
2. Program of the Course of Instruction at the Ecole Nationale des Ponts et Chaussees. No. 620.7 F815 E1.
3. L'Ecole Nationale des Ponts et Chaussees. No. 620.7 F815 E1.
4. Organization of the Ecole des Ponts et Chaussees. No. 620.7 F815 E1.
5. Catalogue of the Library of the Ecole des Ponts et Chaussees. No. 016.620 P232 EP, 3 volumes.
6. Course in Applied Electricity. No. 621.3 F815 N1, 2 volumes.
7. Course in Applied Electricity. No. 621.3 F815 B.
8. Course in Geology and Mineralogy. No. 550 F815 L.
9. Course in Highways and Tramways. No. 625 F815 EP.
10. Course in Methods of Construction. No. 622.21 F815 EP.
11. Course in Hydraulics and Hydraulic Motors. No. 532 F815 S.
12. Course in Reinforced Concrete. No. 691.3 F815 R.
13. Course in Maritime Works. 627 F815 J.
14. Course in Integral and Differential Calculus. No. 517 F815 M.
15. Course in Experimental Mechanics. No. 531 F815 R.
16. Collection of Projects, Special School, 1910–11. No. 620.7 F815 P.
17. Laboratories of the Ecole Nationale des Ponts et Chaussees. No. 620.11 D288.


Rue du Pré - aux - Clercs
Rue des Saints Pères.
Ground Floor.
1 and 3 Physical Instruments.
2 Electrical Laboratory.
4 Printing Office.
5,11,12 Lecture Rooms.
6,32 Professors' Offices.
7 Toilet.
8 Small Model Room.
9 Drafting Room.
Instruments de physique
Laboratoire d'électricité
Instruments de physique
Vestibule 17
Vestibule 20
Modèles 23
Modèles 24
Scale of Feet
10 0 10 20 30 40 50

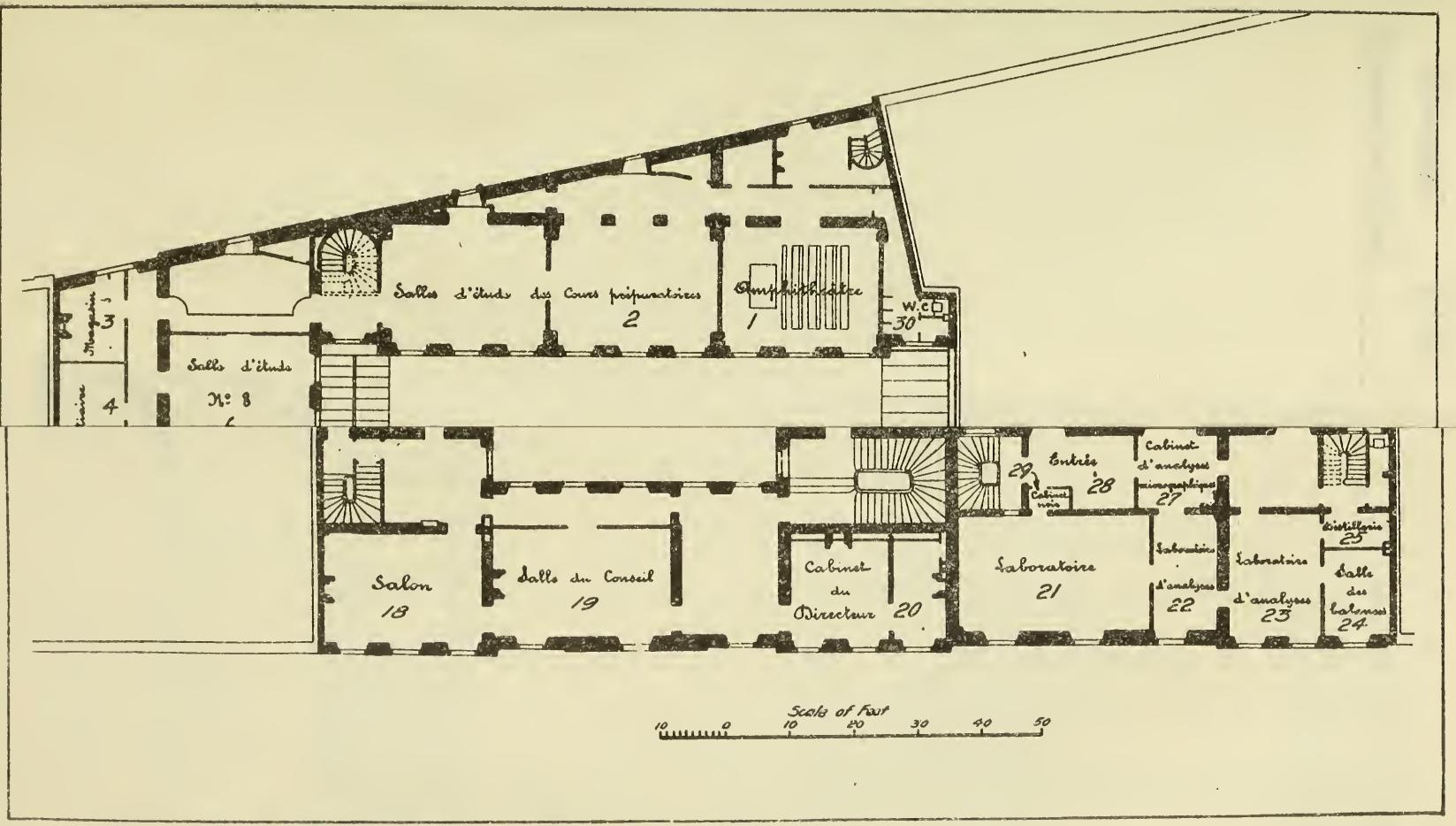


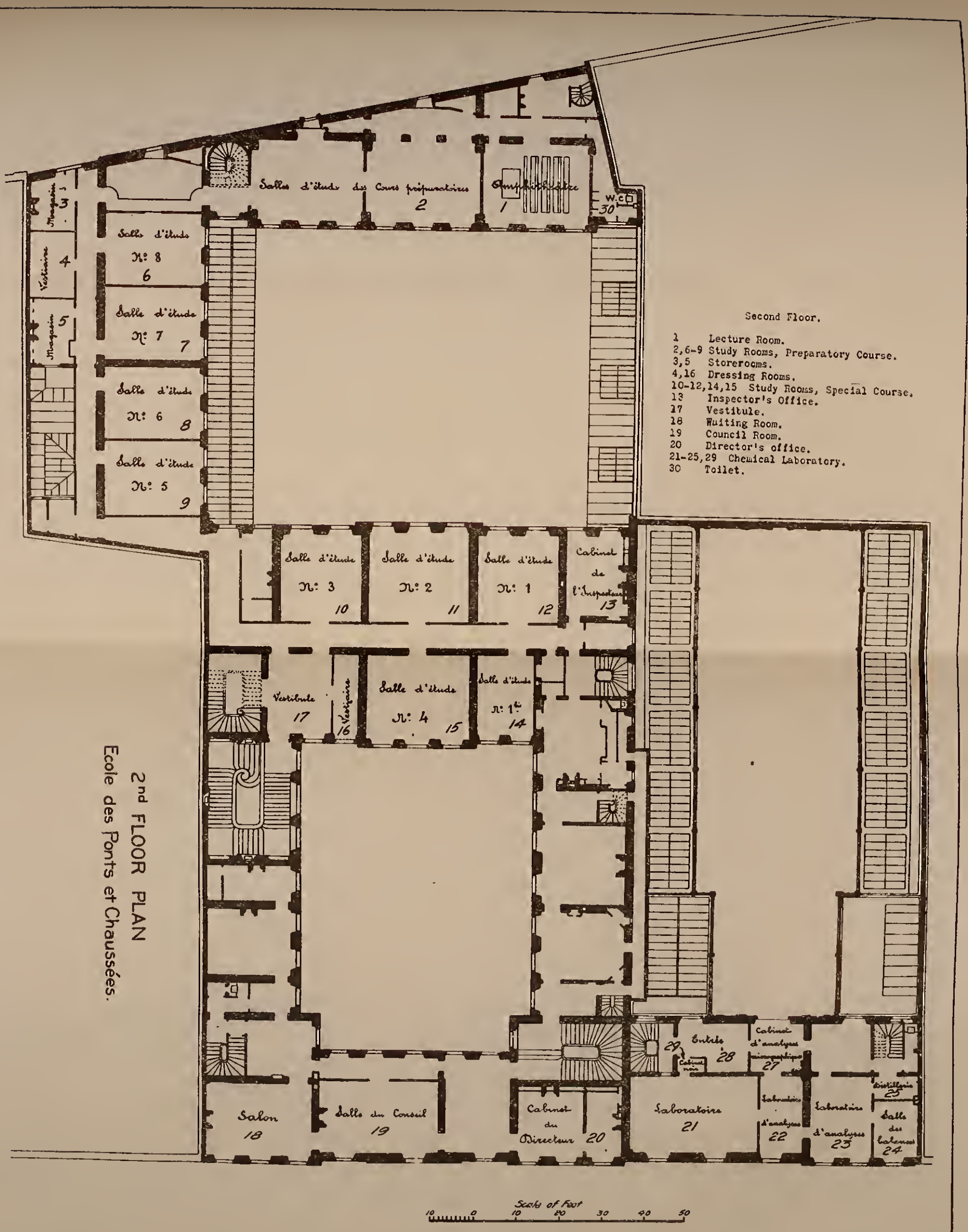
Ground Floor.

1 and 3	Physical Instruments.
2	Electrical Laboratory.
4	Printing Office.
5,11,12	Lecture Rooms.
6,32	Professors' Offices.
7	Toilet.
8	Small Model Room.
9	Drafting Room.
10	Specimen Room.
13	General Hallway.
14	Storeroom.
15	Fuel Room.
16	Telephone Booth.
17,20,30	Vestibules.
18	Architect's Office.
19	Watchman's Office.
21	Instrument Room.
22	Office of Caretaker.
23,24,31	Model Room.
25	Chemical Laboratory.
26	Waiting Room.
27	Storeroom.
28,29	Secretary's Office.
33	Mineralogy Museum.
34	Storage Batteries.

GROUND FLOOR PLAN

Ecole des Ponts et Chaussées.

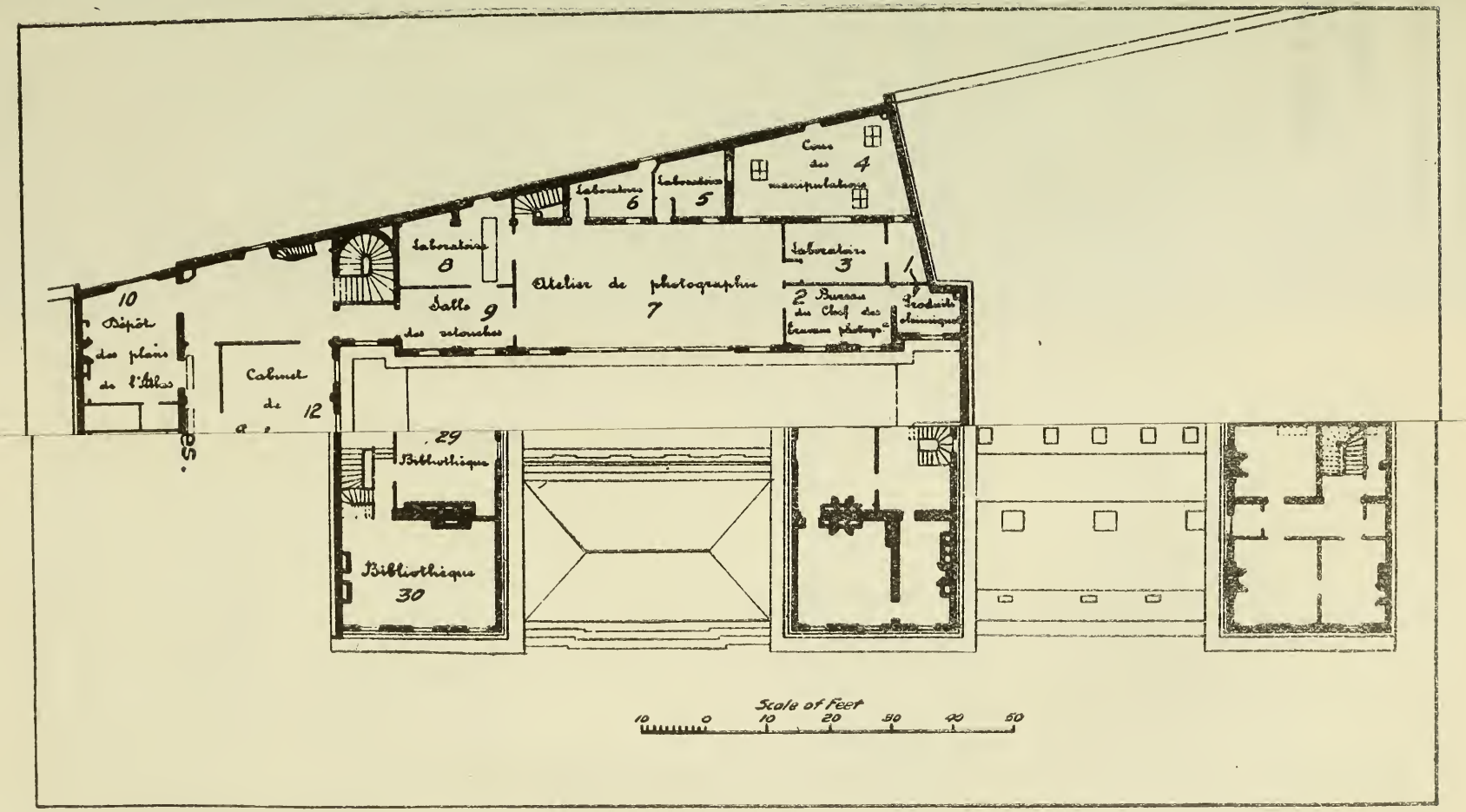

Salles d'études des Cours préparatoires
2
Amphithéâtre
1
W.C
30
Magasin
3
Salle d'étude
N° 8
4
Salon
18
Salle du Conseil
19
Cabinet du Directeur 20
Entrée
28
29
Cabinet
Cabinet d'analyses micrographiques
27
Laboratoire
21
Laboratoire d'analyses
22
Laboratoire d'analyses
23
Distillerie
25
Salle des balances
24
Scale of Feet
10 0 10 20 30 40 50



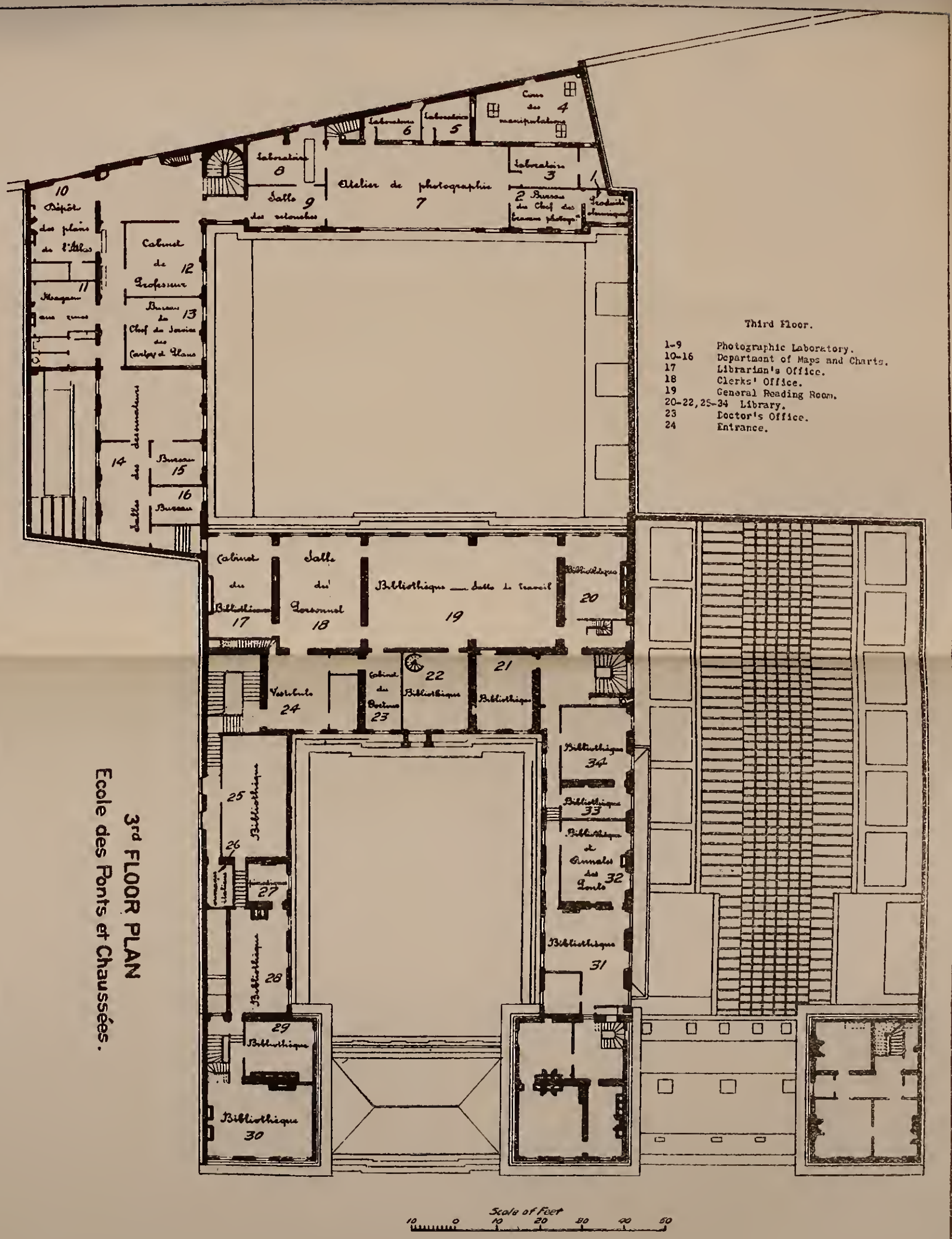
2nd FLOOR PLAN
Ecole des Ponts et Chaussées.

Second Floor.

1 Lecture Room.
2,6-9 Study Rooms, Preparatory Course.
3,5 Storerooms.
4,16 Dressing Rooms.
10-12,14,15 Study Rooms, Special Course.
13 Inspector's Office.
17 Vestitule.
18 Waiting Room.
19 Council Room.
20 Director's office.
21-25,29 Chemical Laboratory.
30 Toilet.



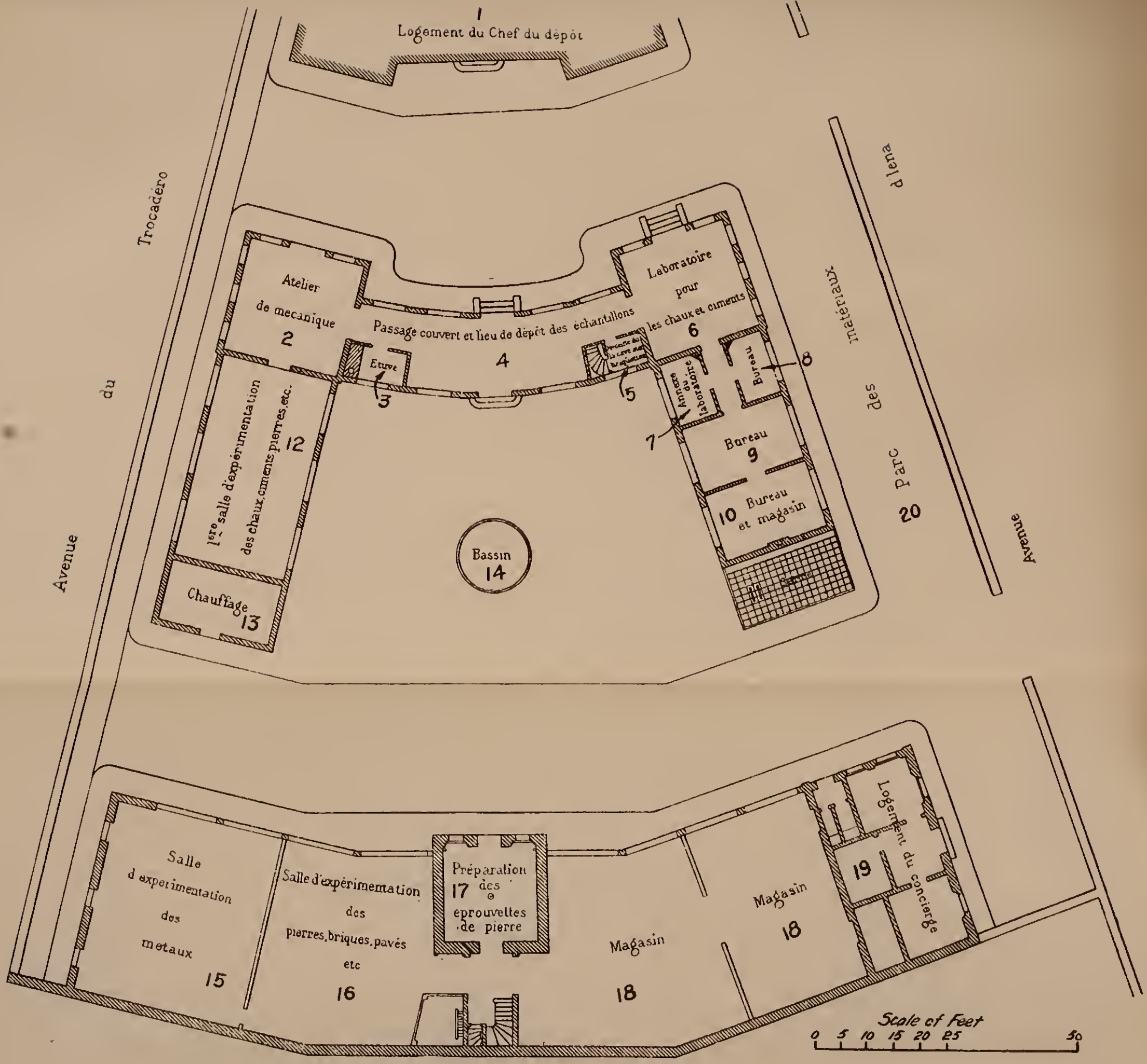
68063—13. (To face p. 42.) No. 3



3rd FLOOR PLAN

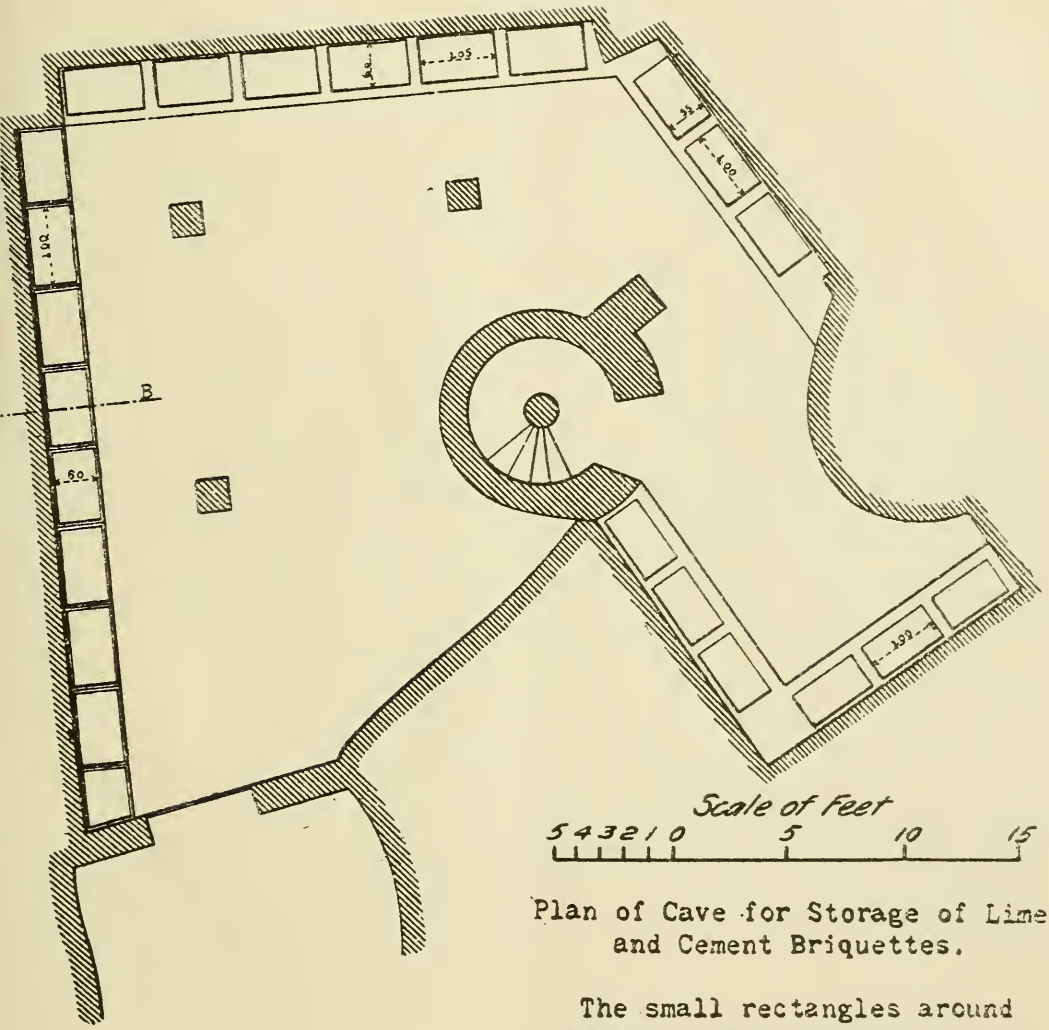
Ecole des Ponts et Chaussées.

Logement du Chef du dépôt



MAIN FLOOR PLAN OF TESTING LABORATORIES OF THE ECOLE DES PONTS ET CHAUSSEES.

1. Superintendent's House.
2. Mechanical Workshop.
3. Drying Room.
4. Covered Way and Sample Room.
5. Stairway to cave.
6,7 Cement Laboratory.
8,9 Offices.
10. Office and Storeroom.
11. Greenhouse.
12. Lime and Cement Testing Room.
13. Heating Plant.
14. Fountain.
15. Metal Testing Room.
16. Brick and Stone Testing Room.
17. Preparation Room.
18. Storeroom.
19. Janitor's Quarters.



Plan of Cave for Storage of Lime and Cement Briquettes.

The small rectangles around the walls are basins where the briquettes are immersed in water.

68063—13. (To face p. 42.) No. 5

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